VANASPATI

PLANTS AND PLANT-LIFE AS IN INDIAN TREATISES AND TRADITIONS

[*Griffith Memorial Prize Essay for 1925*]

BY

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To

My Mother

PREFACE

My thesis on Plants and Plant-life as in Indian treatises and traditions, submitted and finally approved for the Griffith Memorial Prize for 1925, is being presented at last in the following pages to the reading public. I must humbly mention that this thesis is rather a result of certain specific inquiries, undertaken by me in 1923, to satisfy a curiosity as to what wealth of information on the subject of Plants and Plant-life might yet be gathered from Indian literature which is a continuous record of many centuries and a vast store-house of human experiences, fancies and speculations. It was not an easy task for me to face the difficulties of exploiting the various sources of information, specially where these remained concealed in Sanskrit and other Indian works not accessible to me in English translations. It is happy to recall to my mind that when I had proceeded with the task the prospect was far from being bright, but to my great astonishment within a month I was able to collect numerous passages having bearings

upon the subject, and enabling me to conceive a much wider plan of treatment than one restricted to the requirements of the Science of Botany. This is to say, that in this thesis the plan has only been partially carried out. I have little doubt that a vivid account of how much human civilisation has derived from Plants and Plant-life in its progress, on the basis of the materials collected by me, will read like a romance which may be calculated not only to fascinate but also to instruct.

The plan and method of treatment which I have followed in working out the present thesis are intended to meet the demands of a modern student of Botany like myself. The masses of information collected by me have been classified and systematically arranged for the convenience of reference. It will be seen that the chapter-headings are taken from Botanical treatises, and expedience is my only excuse, for, in the absence of any Indian Botanical text there is no other alternative than utilizing a scheme which is available, in order to render the treatment of the subject really systematic. But I think I have not failed to indicate the three different lines upon which the contemplations of the Ancients on Plants and Plant-life had proceeded in India. As a matter of fact the titles of the three Books : Book I—Botany and Philosophic Speculations ; Book II—Botany and Science of Medicine ;

Book III—Botany and Science of Agriculture—have been conceived on the basis of three different lines that I was able to make out.

In the Introduction I have tried to suggest what reply can reasonably be given to the enquiry whether there was at all anything like a Science of Botany in India. It has been suggested that there are not only reference to such individual Sciences as the *Krishitantra*, *Vrikshāyurveda* and *Bheshajavidyā* but clear quotations from such individual authors as *Kāśyapa*, *Parāśara* and *Sāraswata*. And yet I have not gone so far as to maintain that there was any single ancient Indian treatise coinciding with any of the modern treatises of Botany. I have been concerned to emphasise the fact that the ideas of plants and plant-life in India are traced to a stage when Botanical discipline had not obtained an independent position, for much of the knowledge which might be relegated to the Science of Botany appears to have been either subservient to Philosophy, or to the Science of Medicine, or to the Science of Agriculture.

In each Book, and in each of its sections I have dealt with a particular topic, and the information supplied in different heads will, I hope, sufficiently show that though much of the knowledge is common place, there is abundance of scientific observations, classifications, generalisations, theories and applications. While I

leave the following pages to speak for themselves, I must say that in my opinion the supreme value of such a study as mine is rather historical. When I say this I think I have said much. An acquaintance with the accumulated experiences of those who have gone before us, and attempts to grapple with the problems suggested by the phenomena which confronted them, is sure to serve as an inspiration and strengthen us in our belief that the patient investigations which the modern students are carrying out in the field of Botany are of paramount importance for the progress of human knowledge and increase of human comforts.

Among the works consulted I must acknowledge my immense debt to Dr. B. N. Seal's "The Positive Science of the Ancient Hindus." I have freely utilised the translations of the Vedic hymns, the Charaka and Suśruta-saṁhitās, and other original texts rendered by authors whose names have been mentioned at proper places. I regret that from want of time I have not been able to verify all the Latin synonyms of the plants mentioned in the work, and in some cases the Latin equivalents have not been given at all. This is an omission which I hope to rectify should a second edition of the work be called for. I have no pretension to Oriental Scholarship, nor am I a Sanskritist. I cannot perhaps claim

that I have been able to give the subject a full treatment it deserves. I am aware of my shortcomings, but if the account of Plant-life serves to awaken a genuine interest in the study of this subject I shall regard my labour as amply rewarded.

I am very grateful to Dr. B. M. Barua, D. Lit. (London), of the Calcutta University, who gave me his best guidance in formulating the scheme of the work, and I am sure nothing will please him more than the continuation of the present work so as to give completeness to my accounts of Plants and Plant-life as in Indian treatises and traditions. I am also grateful to Mr. R. C. Adhikary, a great lover of ancient civilisation and things Indian, who has never failed to cheer me up with his valued friendship and helped me materially with suggestions and sound criticisms from time to time but for which my work would have been substantially poorer. My thanks are also due to the staff of the Calcutta University Press who have always been patient, courteous and helpful to me—a novice in the matter of publication. I should not conclude this preface without mentioning that my wife has all along associated herself with this humble pursuit of mine, specially in seeing the book through the press and preparing its contents together with the list of the plants mentioned in the text.

As the proofs had to be seen in haste, and that by a hand not at all expert in the business, many ugly errors have crept in, and for these I offer my sincere apologies.

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PLANTS AND PLANT-LIFE

INTRODUCTION

WAS THERE A SCIENCE OF BOTANY?

Botany is a modern science which imposes its own peculiar form of discipline. The subject matter of investigation which comes within its scope falls also within the broader scope of the Science called Biology. But Biology, too, as we know it, is a science of modern origin. The pride of this modern achievement cannot be relished by a people like the Indian conscious of a great historic past. At the same time it will be too much of arrogance and self-sufficiency on the part of the advocates of modern sciences to neglect the whole body of ancient treatises and the whole mass of traditions of a great people by treating them as a tissue of credulity and superstition. In the life of the science of Botany, exactly as in the life of other

sciences, there were earlier processes suggesting its possibility. This may be accepted as a truism. Our enquiry then is—was there anything in India approaching the science of Botany? Were there any earlier processes which enabled the people of this great country to gain in the knowledge of plants and plant-life, and the art of application of this knowledge for the improvement of the general conditions of life?

In Varāhamihira's *Brihatsaṁhitā*[1] as well as in the *Agnipurāṇa*[2], there is a distinct section dealing with the topics of *Vrikshâyurveda*—a term which may be literally rendered "the knowledge of tree-life." The very same term with the additional *Gulma* preceding it (*Gulma-Vrikshâyurveda*) occurs in the *Kauṭilya Arthaśāstra* in the section[3] enumerating the functions of the officer in charge of Agriculture, and his assistants. Whether the term has additional word *gulma* (bushes—shrubs and herbs) or not, the meaning is the same, the word 'tree' where it occurs alone standing for the whole of plant-life in the kingdom of plants; even in the Vedic hymns the term *Vanam*, *Vriksha*, being used almost as synonyms.[4] Of

[1] Chap. 54, Vol.II, pp.743, etc.

[2] Bibliotheca Indica, Vol.II,1876, Chap. 281, pp. 43-44.

[3] Chap. XXIV, p. 115 (Sanskrit original).

[4] Rigveda, X. 81. 4.

the three works in which this significant term is used and a complete section has been devoted to the subject, the first, the *Agnipurāṇa*, is nothing but a popular encyclopaedia of all kinds of knowledge and practices; the second, the *Brihatsaṁhitā*, is a manual containing directions for the applications of the knowledge of astronomy and astrology in practice; the third, the *Arthaśāstra*, is also a handbook discussing matters relating to royal polity and the art of government. Thus all of them are non-Botanical treatises; all are intended not so much to acquaint the students with theories as with practices. In each of the three works we come across a section[1] dealing with the subjects of *Vrikshâyurveda*. The matters dealt with in these sections are of the same character. All of these agree in giving us the impression that the subjects within the scope of the ancient science of plant-life consisted of collection and selection of seeds, germination, grafting, cutting, sowing, planting and nursing, selection of soil, manuring and cultivation of soil under favourable meteorological conditions, and the location of plants for improving the aesthetic and hygienic surroundings of the homestead. There are certain points of difference which are of paramount importance in the absence of any

[1] See supra, p. 2. footnote.

ancient Indian treatises or manuals of *Vrikshâyurveda* coming down to us. The section of the *Arthaśāstra* leaves out of account the central point doing justice to the title of the ancient science *Vrikshâyurveda,* namely, the 'treatment of plant-diseases and prescriptions for remedies.' This point comes out prominently in the *Brihatsaṁhitā* and the *Agnipurāṇa.* On the other hand, the section of the *Arthaśāstra* is not without a special importance not only for its antiquity but also for a clear statement in which the ancient science of plant-life appears to be treated as a sub-head of *Krishitantra,* a term obviously signifying a treatise on Agriculture. The statement is quoted below[1] :

"सीताऽध्यक्षः कृषितन्त्रगुल्मवृक्षायुर्व्वेदज्ञस्तज्ज्ञसखो वा सर्व्वधान्यपुष्पफलशाककन्दमूलवाल्लिक्यक्षौमकार्पासबीजानि यथाकालं गृह्णीयात् ॥"

By this the officer in charge of Agriculture and his assistants are supposed to be conversant with the treatise of Agriculture (*Krishitantra*) and knowledge of the life of Bushes and Trees, and well trained in the art of utilisation of their knowledge. Dr. Shama Shastri in his translation has represented *Krishitantra* as a science or scientific treatise dealing with *Gulma-Vrikshāyurveda* and he cannot but do so in regard to

[1] For English Translation—see Shama Shastri, Chap. XXIV, p 138.

the matters dealt with in this particular section. But from the construction of the sentence it is clear that *Krishitantra* and the *Gulma-Vrikshâyurveda* are two separate terms used to denote the two departments of knowledge. If in a particular context one has been treated as a sub-section of the other, necessarily, the implication is not that the departments of knowledge signified by them were not independent ; the point which is clear from the *Arthaśāstra* is the interdependence of the two. A treatise of Agriculture will be incomplete without a chapter dealing with the application of Botanical knowledge to the art of plantation, cultivation, manuring and the rest. In the other two references the term *Vrikshâyurveda* looms large and the *Krishitantra* does not find any mention. But here, too, the purpose is just to show the application of the knowledge relating to ancient science of plant-life for agricultural, horticultural, irrigational and economic purposes.

The question is—did the authors of the three treatises really intend cataloguing some useful prescriptions for utilisation of this knowledge to exhaust the contents of the science contemplated by the term *Vrikshâyurveda* ? The answer must be in the negative. If the sections in the three non-Botanical treatises mean anything, it must be that there was in existence an independent treatise or treatises upon which the

prescriptions contained in them were based. They may be taken also to mean, no doubt, that the Ancient Botanical Science was developing at first along with the Art of Agriculture before it gained an independent foothold of its own.

Are we to suppose that the knowledge of plant-life developed along with the Science of Agriculture alone? First, let us enquire if there were any separate treatises devoted to the two sciences, one relating to agriculture, and the other to the knowledge of plant-life. Varahamihira's commentator—Bhaṭṭopāla—in explaining the prescriptions in the section on *Vrikshāyurveda*, has elucidated the points by certain quotations from three ancient authors, namely, Kāśyapa, Parāśara and Sārasvata. It seems probable that the treatises ascribed to these authors were primarily concerned with *Krishi*—the art of cultivation, *Krishi-Parāśara* being the traditional title of a treatise associated with one of these authors. There is no reference as yet found out where *Krishitantra* and *Vrikshāyurveda* have been exchanged one for the other. If it stands out from the sections in the *Brihatsaṁhitā* and *Agnipurāṇa* that the treatment of plant-diseases and their remedies was one of the subjects of investigation falling within the scope of the Botanical science, it may be supposed to have formed, so far as this point is concerned, also a subhead for the ancient Indian science of

Medicine. So far as the recorded evidence goes, the reference indicating the close association of the knowledge of plants and plant-life with the art of healing are much earlier and plentiful. We shall briefly examine below two Vedic hymns—one in the Rigveda and the other in the Atharva Veda, and see what light they throw on this point:

In the hymn of the Rigveda[1] the poet speaks of 107 applications of plants to make people free from diseases, the plants bearing flowers and fruits, etc. There is not a single utterance in the whole hymn referring to applications of the knowledge of plants for agricultural and other purposes.

In the hymn of the Atharva Veda[2] the different herbs and plants are named, classified and praised only for their medicinal properties. There is not a word about the connection of the knowledge of plants with agriculture, irrigation, and the rest. And this is just the typical of several other hymns that corroborate the point.

The popular Indian word *auṣadha* denoting medicine is derived from or connected with *Oṣadhi* signifying the annual herbs. Even at the present day, in some parts of India, the word *dāru* or tree is used to denote medicine, and in

[1] Rigveda, X, 97.

[2] Atharva Veda, VIII, 7 (pp. 498-500, Whitney).

some parts to denote the alcoholic substance, *i.e.*, the *Soma*. The moon bears the designation of *Oṣadhinātha*—the lord of herbs, here *Oṣadhi* being a synonym of 'Soma' which, according to the above hymns of the Vedas, was the king of the herbs and plants. The word *bheshaja* from which *bhishak* denoting physician is derived, etymologically means "vegetable drugs."

In an expressed opinion in the Charaka-saṁhitā[1] it is only the man well acquainted with the names, and external features of plants, and able to use them properly according to their properties is to be called an expert physician.

The Dhanvantari Nighaṇṭu[2] which is more explicit on this point says,—" Sometimes several

[1] Sutrasthana, Chap. I. Verses 51-53

[2] एकन्तु नाम प्रथितं वह्ननाम् ।
एकस्य नामानि तथा वह्ननि ॥
द्रव्यस्य जात्याकृतिवर्णवीर्यं ।
रस प्रभावादि गुणैर्भवन्ति ॥
वह्नन्त: प्राकृत-संस्कृतानि ।
नामानि विज्ञाय वह्नंश्च पृथ्या ॥
दृष्ट्या च संस्पृश्य च जाति लिङ्गै: ।
र्विद्याद्भिषग भेषज मादरेन ॥

Cf. Preface to the Raja Nighaṇṭu of Narahari where he says :—

नानाविधौषधि रसाह्वय वीर्य्यपाक
प्रत्येक सम्यगववोधकृत श्रमोपि
मुह्यत्यवश्यमनवेच्च निघन्टुमेतम्
तस्मादयं विरचितो भिषजां हिताय ।

Also Rasaratnasamuchchaya—Chap. VII, 32 " Such herbalists as are not deceitful and are well-versed in the knowledge of the drugs

healing vegetables (*bheshajas*) bear one name, sometimes one vegetable bears various names according to its class, external feature, colour, potency, function (*rasa*), effects, properties and the rest."

"The physician does well to master *Bheshaja-Vidyā* by acquainting himself with the various names of plants in Sanskrit and Prakrit, consulting all classes of men, by personal observations, by a careful handling, as well as, by a careful consideration of its specific characters and sexuality."

In this quotation we find the use of a technical term *Bheshaja-Vidyā* signifying a distinct study of the plants and plant-life with special reference to medical properties and use.

Here, too, the same question is apt to arise, does this study complete the contents of the ancient Botanical science? We must say, No. Throughout Indian literature we find the theories about the evolution of plants, about the

and plants, and in the language of many countries should be employed." (P C. Roy's History of Hindu Chemistry, Vol. I, p. 65. Calcutta, 1902.) Also the final test to which Bhikshu Ātreya, the celebrated teacher of medicine in the University of Taxila, put his equally celebrated pupil Jīvaka, afterwards the physician of Bimbisāra, in collecting, identifying and describing the properties of plants to be found within four Yojanas of the University town. (Vijayratna Sen—Preface to Viraja Charan Sen Gupta's Vanaushadhi-Darpaṇa, Vol. I, 1908).

nature of plant-life, the position of plants in the whole scheme of nature and the like, developed along with the various philosophical speculations.

Even for a brief survey of the entire field of Indian Botanical Science we must trace its developments in these three different lines:

(1) As under the Philosophic Speculations.
(2) As under the Science of Medicine.
(3) As under the Science of Agriculture.

Accordingly the thesis is divided into three books bearing the following titles:

Book I.—Botany and Philosophic Speculations.
Book II.—Botany and Science of Medicine.
Book III.—Botany and Science of Agriculture.

Book I

BOTANY AND PHILOSOPHIC SPECULATIONS

SECTION I

General Observations

The daring philosophic speculations and fanciful popular notions are always in advance of science. The hymns of the Vedas, the texts of the Upanishads, the Epics and Purāṇas, the Buddhist and Jaina canonical works and commentaries, the medical treatises of Charaka and Suśruta, the lexicon of Amara and such other works yield us plenty of materials indicating how the knowledge of plants and plant-life came into clear recognition, and the Botanical science developed on various lines. The information culled from these sources can be considered under the following heads :

I. Germination of seeds.
II. Morphology—External, *i.e.*, general description of Plants.
III. Morphology—Internal or Histology.
IV. Physiology.
  1. Nourishment.
  2. Absorption, Transport, Transpiration and Assimilation of food.
  3. Planting.
  4. Manuring.

5. Treatment of Plants.
6. Respiration (Breathing).
7. Movement—Irritability.
8. Growth.
9. Age and Death.
10. Consciousness in Plants.
11. Sexuality.
12. Reproduction.
13. Heredity. (Appendix A.)

V. Ecology—Study of Plants in their natural surroundings (homes).

VI. Taxonomy.

1. Nomenclature or the naming of Plants.
2. Classification or the grouping of Plants based on—
   (*a*) Botanical principles.
   (*b*) Medicinal properties.
   (*c*) Dietic value.

VII. Plants and Evolution.

VIII. Miscellaneous application of the Study of the Science of Plant-life—

1. As a means of Economic predictions.
2. As a means of ascertaining the presence of water in a dreary region.

SECTION II

GERMINATION

The process of germination is technically called *ankurődbheda*, a term which means sprouting, *i.e.*, the awakening of life latent in the seed under certain given conditions. And the conditions are—supply of air, water and warmth. We read in the Suśruta[1]:

ऋतु क्षेत्राम्बुवीजानां सामग्र्यादङ्कुरो यथा—

"Just as the proper season (*ritu*), good soil (*kshetra*), water (*ambu*), and vigorous seeds (*vīja*), together with proper care, help the germination of strong and undiseased sprouts..."[2]

Again in Guṇaratna's Commentary on the Ṣaḍdarśana-samuchchaya:

वटपिप्पलनिम्बादीनां प्रावृड्जलधरनिनादशिशिरवायु-संस्पर्शादङ्कुरोद्भेदः ॥

"The seeds of *Vata* (Ficus Indica), *Pippala* (Ficus Religiosa), *Nimva* (Melia azadirachta) and

[1] Suśruta, Śārīrasthāna. ii, 33.

[2] Vol. II, p. 129, English Translation by Kunjalal Visagratna, 1911.

the rest, sprout during the rainy season under the influence of dew and air (when sown)."[1]

The following aphorisms of Khanā also contain the following direction of aerating the soil for different plants :

" For the successful cultivation of cotton one has to plough the land 16 times, for radish 8 times, for paddy 4 times and for betel nil."[2]

The soundness of the directions becomes at once manifest when one takes into consideration that cotton plant has an elaborate root-system, radish is a herb, paddy is a surface feeder, and betel is a climber that produces numerous adventitious aerial roots.

From the above we see that the factors of air, water and warmth (proper season) are regarded as necessary for successful germination of seeds.

The seedling is called *ankura*, *avinavodvid*, which etymologically means that the plant becomes visible for the first time by it. Scientifically this term is more accurate than its English synonym " seedling ".

Although the ancients laid down the conditions of germination arrived at by practical experience, they have not, so far as our knowledge

[1] Guṇaratna's Commentary, Śloka 49, p 157. Ṣaḍdarsana-samuchchaya, Bibliotheca Indica, new series 1151, 1907.

[2] ষোল চাষে তুলা, তার অর্দ্ধেক মূলা।
তার অর্দ্ধেক ধান, বিনা চাষে পান॥

goes, cared to state the stages of germination as is done in the modern treatises on the subject. Yet the Sanskrit word *uttānapāda* taken from the vegetable world is significant. During germination it is the Radicle (*mūla*, *pāda*), the primary root, that comes out first, even in whatever position the seed is placed. The words *uttānapāda*, *ūrddhvamūla* mean "the root foremost." Thus it is not inconceivable that they did not fail to notice the first stage in germination.

SECTION III

The General Description of Plants

The rudiments of morphology may be traced as early as in a hymn of the Atharva Veda[1] where we get a rough description of the external features of plants :

" The spreading, the bushy, the one-spathed, the extending herbs do I address, those rich in shoots, jointed, that have spreading branches ; I call for thee the plants that belong to all the gods, formidable, giving life to men." (4.)

" Rich in sweets the root, rich in sweets the tip of them, rich in sweets was the middle of the plants, rich in sweets the leaf, rich in sweets the flowers of them, etc." (12.)

" Rich in flowers, rich in shoots, rich in fruits, also those lacking fruits—like joint mothers, etc." (27.)

A more systematic statement in brief occurs in the Vrihat Âraṇyaka Upanishad[2] where we get an accurate description of the life history of a plant. Thus :

" * * * the essence of water is embodied in plants such as grasses, creepers and the rest, flowers represent the essence of plants, and the

[1] Atharva Veda VIII, 7. Whitney Ed.

[2] V. A. Upanishad, 4.6.1.

essence of flowers are fruits, such as paddy, wheat and the rest."

We again read in the *Vishṇupurāṇa*[1] a description of the parts of a complete plant. The type given is that of paddy. Thus:

" O the greatest of sages, just as there are embryo (*aṅkur*), root (*mūla*), stem (*nāla*), leaf (*patra*), flower (*pushpa*), milky sap (*kshīra*), husks (glumes—*tūsha*), seed-vessel (*kosha*, *vīja kosha*), seed (*taṇḍula*, rice) and endosperm in seeds (*kaṇā*) in the paddy, and they become manifest only under suitable conditions such as soil, water, etc."

The quoted passages contain terms and expressions covering the whole of the external feature of plants which we now call External Morphology. The points that are to be noted, according to these passages, comprise root, stem, leaf, flower, fruit, seed, etc.

All plants are divided broadly into two parts:—A subterranean called the Root (*Mūla*, *Pāda*), and a sub-aerial called the Shoot (*Vistāro*). Let us now consider what the Ancient Botanical Science has got to teach us on all these points taken one by one.

1. **Root.**—The Sanskrit equivalent of this organ is significantly expressive at once of its function and location. It is called *mūla*, *i.e.*, by its means the plant is fixed to the soil. The

[1] 7th Chapter, Ṣlokas 37-39, Bangabāsi Edition, p. 121.

plant is called *pādapa*, *i.e.*, by its pādas (*mūlas*), the plant drinks (absorbs) water (*rasa*—watery solution) from the soil. Adventitious roots are called *śākhā śiphā* (fibrous roots springing from the branches). Fibrous roots are called—*śiphā*, *jaṭā*. Adventitious roots hanging from spreading branches (prop roots of Ficus indica, also of Tinospora cordifolia) are called *abaróha*, *i.e.*, that which goes down, hangs. We also learn from Arthaśāstra,[1] Charaka, Upanishads, etc., that people used to take it as food and in this connection we find mention of 'bulbous roots' as distinguished from typical ones.

2. **Shoot.**—The shoot is divided into stem and leaves. The main stem (trunk) is called *prakāṇḍa*, *i.e.*, it is that part which is between the main root and the place from which branches originate. It is also called *skandha* as it bears the head or crown. The stem may be weak or strong and so are the plants having them. Strong stemmed plants are called *vanaspati*, *vānaspatya*, etc., they stand erect. The weak stemmed plants cannot support themselves, and according to their habit they are distinguished into—a creeper and a trailer. A creeper is called *vallī*, *vratatī*, or *latā*. The creeper includes both a twiner and a climber. *Latā* means that which embraces, twines. It also means a weak plant that goes from the root to

[1] Arthasāstra, Section 24, p. 138, Shama Shastri's Edition, 1932.

the top of a tree (*mulāchchāgra yatān latā*). By the term *latā* is meant the whole range of lianes. (वल्ली वेष्टयते वृक्षं—Śānti Parva).

The other kind (trailer) is called *protānino*, spreading one,—that which spreads on the ground. This includes both the procumbent and the decumbent.

3. **Stem** :—The stem may be plain or jointed (*śata parva*). Each joint or node is called a *parva* or *granthi*. Leaves spring from the joint (स्तम्बे गुल्मे तृणादीनां काण्डद्रुमगुच्छयोः). Plants may be with stems or stemless. Stemmed plants are called *sakāṇda*, and stemless plants are distinguished as *aprakāṇḍa*, *stamba*. Plants having short or stunted roots and branches are called *kshupa* (क्षुपः—ह्रस्वशाखा शिफः). The primary branches are called *skandaśākhā*, and secondary and tertiary ones are known as *praśākhā* (प्रशाखाः); *pratiśākhā* and *anuśākhā* (प्रतिशाखाः and अनुशाखाः) are also used. [1] The branches generally are known as *śākhā*, as the plant (*śākhina*) spreads by them. Branchless stems are called *sthānu* or *śaṅku*. Apex of the tree, *i.e.*, the tree-top is called शिरस्, *agra*, *śikhara*, *i.e.*, where one cannot climb, or which cannot be reached.

Trees, shrubs and herbs used to be distinguished by the long or short, hard and strong

[1] Vishṇupurāṇa, 3rd part, 4th Chap, Śloka 25.

or less strong and succulent stems. Plants growing on other plants (वृक्षोपरि वृक्षे) are known as *pargāchhā* (परगाछा इति ख्याते). These include both Parasites and Epiphytes. Parasites are called *vrikshādanī* (cascuta—वृक्षादनी वृक्षमत्ति युः), that which (guest) eats (अदन—sucks food from) another tree (host). Epiphytes are called *vriksha-rūhā* (वृक्षरुहा—वृक्षे रोहति इति), *i.e.*, that which simply lives on another tree without drawing nourishment from the latter. One of the examples given is *Guduchi* (Tinospora cordifolia)—it is called *chhinnarūhā* (छिन्नरुहा—छिन्नापि रोहति जायते कः)—"it grows and lives even when torn." Another example Vanda Roxburghii Br., *i.e.*, Orchid (*Rasna*) is known (Colebrook), but its habitat is not described. (See infra, classification). Lower plants such as Mosses and green Algae are noticed but not described (such as जलनीली तु शैवालंम्—Amara). Saprophytic plants, such as Mush-rooms (plants with no fruits and flowers), are correctly described with their habitats, but not separately classified. Mush-room is thus described :—it is called *Chhatrā* (छत्रा) [1] as its shape is exactly like that of an umbrella. "It is generally found to grow on stalks of straw (*palāla*), or is seen vegetating on the stems of bamboo (*veṇu*) or sugar-cane, or as sprouting up from beneath the surface

[1] Mushroom, Colebrook, p. 125 (Amarkosha).

of the ground (*udbhida*), or growing on a heap of decomposed cowdung (*karisha*)."[1]

Underground stems and such roots as Radish (hypocotyl modified) are called *kanda*. These are described as 'like roots, but not roots, serve as a means of propagation' (**यन्मूलमेव वीजं स कन्दः**). As examples are mentioned :

Ol (Corm), 6 kinds of *Potato* (Tuber), *Mūlaka* (Radish), *Gājar* (Carrot), *Plantain* (Rhizome), *Mānkachu* (Arum-Rhizome), *Palāṇḍu* (Onion-Bulb) and *Mahā kanda* (Garlic).

4. **Leaf** :—The leaf is called *patra*, because it falls soon, it is also called *parṇa* because of its green colour. The stalk of the leaf when present is called *brinta*, and the petiolate leaf is called *sa-brinta*. New leaves are called *pallava*, *kishalaya*. Branches with undeveloped leaves (*pallava*) are called *vistāro* as the plant spreads by it. It is synonymous with modern 'bud.' Leaves may be simple when it is called *eka-patra*—one-leaved. Compound leaves are described by the number of leaflets they contain, *e.g.*, *dvi-patra* (Bauhinia?), *tri-patra* (Ægle), *sapta-parṇa* (Echites scholaris). Leaves are also described by their shapes such as *aśwa-parṇaka* (Shorea robusta)—as the leaves resemble the ear of a horse; *mushika-parṇí* (salvinia)—as the leaves resemble the ear of a mice ;

[1] Suśruta, Sutrasthāna, Chap. XLVI., p. 522, English Trans. K. L. Vishagratna.

kîśaparṇî (Achyranthes aspera) monkey-ear-shaped leaves, and so on.

5. **Flower** :—The flower is called *sumanasa* —that which pleases mind, it is called *pushpa* because it opens; it is called *prasūna* because it is born (from plants). Unopened flower bud is called *kalikā*, *koraka*, *i.e.*, that which produces (fruits, etc.). Opening flower bud is called *kutmala*, *mukula*. Full blown flowers are called *vikacha*, *sphutāḥ* (विकसितं सितं).

Bunch of flowers, *i.e.*, Inflorescence, is called *stabaka*, *guchchhaka*.

A compound pedicel is called *vallarī*, *mañjarî*; Helicoid cyme is called *śrihastinī* (resembling the trunk of an elephant). The inflorscence of umbelliferous plants is called *chhatrā*. छत्राकार स्तवकः is umbel. Flower stalks (pedicels) are called *prasava-bandhana*, *i.e.*, that which binds flowers and fruits with the mother plant. Shape of the flowers in some cases is also noticed, *e.g.*, papilionaceous flowers are called *vakra pushpa* (Sesbania). Petals are called *pushpadala*, and sometimes number of petals are counted such as *śatadala*, *sahasradala*. Stamens are known as *keśara*; *kiñjalka* is the hairy part (सूत्रवत् अंश) within flowers; pollen grains are called *keśara-reṇu* (stamen dusts), they are also called *parāga* (पराग), as they go fast (परा) being very light and carried by air. They are also called

सुमनोरजस्—dust in flowers. Ear or spike of a corn is called *kiṇasham*, *śasyamañjarī*.

6. **Fruit:**—The fruit is known as *phala*, *i.e.*, the result of a previous process. Green fruits are called *śalātu*, dry fruits are called *vāna*, and fleshy fruits, such as gourd and the like, are called *kshāraka*, *jālaka*. A legume or pod is called *śamī*, *śimba*, and the seeds in it *śamī dhānya*.[1]

Classification of fruits:—Was not based on any scientific principle. Their classification was rather governed by etymological consideration, *i.e.*, names used to be given in allusion to trees, their origin etc., *e.g.*,

Amra (आम्र) or mango, fruit of mango tree.

Jambu (जम्बु) or black-berry, fruit of Eugenia jambolana.

Aingud (ऐङ्गुद), fruit of *Ingudi* (Balanites Roxburghii).

Plāksha (प्लाक्ष), fruit of *Plaksha* (Ficus infectoria).

Vaiṇaba (वैणव), fruit of *Veṇu* (Bamboo).

Vārhata (वार्हत), fruit of *Vrihatī* (Solanam indicum).

Naiyagrodha (नैयग्रोध), fruit of Banyan, and so on.

7. **Seed**:—The seed is called *vījam* (वीजम्), that out of which something grows. Seeds are

1 Amarakosha, Colebrook's Edition, p 226.

enclosed in a vessel called *vījakosha* or seed-vessel. Seed-vessels are sometimes identified with integuments (seed coats) and sometimes with pericarp (ovarian wall). The kernel is called *śasya* (endosperm) and the cotyledon is called *vījapatram* (वीजपत्रम्).

SECTION IV

Morphology—Internal or Histology

The Ancients broadly differentiated the stem into two parts—an outer called the *tvach*, *valkala* (rind, skin); and an inner the wood or essence—the *sāra* (सार), *i.e.*, that which lasts till the end of time (कालान्तरमिति) enclosing the *majjā* (the pith). The outer part included the modern bast and the inner part the wood with pith as usual. Thus the stem is internally differentiated into—

(*a*) an outer rind,

(*b*) the wood on which the softer parts are fixed, and

(*c*) the pith enclosed within the wood as marrow by the bone.

A more elaborate attempt is seen in the Vrihat Āraṇyaka Upanishad,[1] where the inner structure of plants is described after the analogy of the human anatomy.

Thus:

"The body of the plant is exactly like the body of man; the *hairs* of man corresponding to the *leaves* of plants and his *skin* (त्वक्)

[1] Chap. III. 9th Brāhmaṇa, Lotus Library Edition, pp. 1004-5.

corresponding to the *dry exterior bark* of the plants" (231-28-1).

"The flesh of the human body answers to the *śakara* (soft tissue next to skin) of plants: his nerves standing for the *kināta* (fibrous tissues in śakara as in jute, etc.) of plants, both being equally strong. Just as the bones of man lie behind his flesh, so also wood, *dāru*, lies behind the śakara (and occupying the centre) of plants and the marrow (pith) is alike in both" (236-30-3).

Thus the internal structure of plants is evidently divided into an outer skin (epidermis and dry bark) and the inner wood between which stands a softer tissue (bast) with strong fibres (bast fibres) corresponding to human flesh with nerves. The wood encloses a soft pith. This division is not altogether fanciful, as it contains an essential broad truth which has not been made obsolete by the elaborate scientific modern researches.

A curious advance in the knowledge of plant life is displayed in Śankara Miśra's Upāskara where he notes (वृद्धिक्षतभग्न संरोहणे च)—the growth of organs (or tissues) by natural recuperation after wound or laceration.[1] Also "the closing up of fracture (in plants) are manifest means of fruition."[2]

[1] Upāskara on Vaiseshika Philosophy—4·2·5·—the Sacred Book of the Hindus Series, Vol. VI, Panini Office, pp. 159-60.

[2] *Cf.* also Gough's Trans., Benares, 1873, pp. 147-148.

In Guṇaratna's commentary[1] also we notice a reference of healing up of wounds in plants. Thus:

"यथा मनुष्यशरीरस्यौषधप्रयोगाद्वृद्धिहानिक्षतभुग्नसं-
रोहणानि, तथा वनस्पति शरीरस्यापि ।"

[1] Bibliotheca Indica, New Series, 1151 (1907).

SECTION V

Plant Physiology

1. **Nourishment**—*General.*—Guṇaratna in his commentary on the Ṣaḍdarsana-samuchchaya[1] very aptly describes the influence of soil and food upon the vegetable system in producing health and disease :

"तथा, यथा मनुष्यशरीरं स्तनक्षीरव्यञ्जनोदनाद्याहारा-
भ्यवहारादाहारकम् एवं वनस्पति शरीरमपि भूजलाद्या-
हाराभ्यवहारादाहारकम्। तथा, यथा मनुष्यशरीरमिष्टा
निष्टाहारादि प्राप्य वृद्धिहान्यात्मकं, तथा वनस्पति-
शरीरमपि।"

"Just as the human body receives sustenance through the assimilation of the mother's milk, dishes, etc., so also the vegetables assimilate food according to the nature of the earth (soil), water, etc."

"Just as the human system is at ease and is diseased according as it takes wholesome or unwholesome food so also plants grow or decay by assimilation of suitable and unsuitable food."

Thus connected with the nourishment of plants the most important factor is the soil—

[1] Bibliotheca Indica, New Series, 1151 (1907).

the principal source of sustenance. It is roughly divided into *urbbarā* (सर्व्वशस्याढ्या—fertile with every crop), and *ūshara*[1] (barren or sterile on which nothing can grow). The fertile soil being that which is capable of supplying the plants with their necessary food materials while the sterile soil is that which does not possess this capacity.

2. **Absorption, Transport, Transpiration and Assimilation of food.**—Plants draw food materials from the soil through the help of the roots which constitute exactly what is mouth to man, another name for tree being पादपः, *i.e.*, that which drinks through roots. It is common knowledge that the food materials from the soil enter plant organism in the shape of liquid and not solid, and the ancient etymology evidently anticipated the accuracy modern scientists.

The elaborate process by absorb, transport anu [1] described in the follu Mahābhārata.[2]

"Just as water may the lotus petiole applied to plants (with roots) drink (a solution) with the help of ai-

[1] ऊषरे न प्ररोहन्ति बीजाङ्कुराः कथञ्चन । मनु
p. 701, Bangabasi Ed. 1316 B.S.

[2] Sānti Parva, Chap. 184 p. 855 (Basumat

The comparison is evidently significant. In drawing water through the lotus petiole a force —a sucking force—in the mouth which draws in, is pre-supposed, as also uninterrupted passages in the petiole through which the water is to go up. The one end of the petiole is dipped in water and the drawing force is applied to the other. The similie does not stand on all fours because water stands for the liquid food materials from the soil, the uninterrupted passages stand for similar passages in the stem, but the drawing force is wanting. We clearly see that food materials are drawn up in the case of the plant as water is drawn in the case of the man in whose mouth there is the sucking force. But we do not see which draws up the f... materials in the case of plants? Rational-
...e one case as in the other there must
... without which the action cannot

... the hypothesis only
...e knowledge of the
...king force in the leaves of
the existence of a sucking
man—a knowledge which
...t discovery, was an accom-
... the ancients. The func-
...taining the sucking force
...ned. We now know that
hence transpiration force

(suction force in leaves) is greatly accelerated by air.

After the food materials in solution are brought into the leaves the process of assimilation (ओषं) commences, which is thus well-described:

"Agni (energy) and air (CO_2?) help in the digestion (assimilation) of the water (watery food materials) which is absorbed through the roots of the trees (and conveyed to the leaves). And it is on account of the assimilation of this watery solution that the vegetable kingdom undergoes development and becc graceful."

Thus a thorough
tion and assimilat
the depender
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mean 'fire'
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sustenance of life, bei
processes; and 'air' w
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of the carbon in the form
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5

We have so long hypothetically assumed the existence of the leaf as the centre of sucking force, and practically the kitchen where the food of plants is prepared. What warrants us in the assumption ? Besides the full-fledged development of the scientific knowledge of nutrition, we have in some of the provincial proverbs attributed to the mythical Khanā, the depository of the wisdom of ages, a distinct knowledge of the function of leaves in the maintenance of plant-life pre-supposed. A proverb[1] runs :

"After you have planted the plantain trees,
...ves, and this will bring
..."

... is fully made
... is seen to be

...phasising
...uns[2] :
... world that paddy
...betel under shade."
... is that during rainy
... available solar energy
will be the production and
...e paddy. But, for betel
... the leaves and the
...Ve know that the

...ড় তাতেই ভাত।"
... পান।"

shade-loving plants have larger leaves, and even when a sun-plant with narrow leaves is transferred to a shady place it tends to develop larger leaves. The cause of the pungency is also due to the absence of sun-light, and the reason is that the destructive metabolism cannot reach its final stage and consequently more acid and other astringent bye-products are formed. The other proverb is [1] :

" The paddy develops day by day owing to sunshine by day and water by night."

The modern scientific explanation of the fact would be that during day time with the sunshine food is prepared, assimilated and stored and during night time the growth of the organism takes place, and for this a supply of water is needed. The Ancients broadly knew the utility of these two factors, although they by no means seem to be acquainted with the scientific details.

That water besides going up to the leaves also circulates all over the trees, and this circulation is not due to sun's rays, etc., is also noticed by Kaṇāda in his Vaiśeshika Philosophy.[2] And Śankara Miśra in his Upaskara[3] has tried more elaborately to answer how water circulates in trees. Thus :

[1] "দিনে রোদ রাতে জল, দিন দিন বাড়ে ধানের বল।"

[2] Kaṇāda. 5-2-7. "वृक्षाभिसर्पणमित्यदृष्टकारितम्।"

[3] S. B. H. Vol, VI. p. 177 (Panini Office).

"The circulation (of water) in trees is caused by *adrishtam*[1] (destiny)."

Upāskara commenting on the above aphorism explains :—" Water poured at the roots goes up in all directions through the interior of a tree. Neither impulse, nor impact, nor the sun's rays prevail there. How then is it caused ? The action by which waters rise, and cause the growth of the tree results from conjunction of destiny with the souls of those in whose souls pleasure and pain is effected by the growth of the leaves, stem, fruit, flowers etc., as its non-coherent cause ; from destiny as its efficient cause, and in water as its co-inherent cause."[2]

That water rises up in trees is also mentioned in the *Bhāgabatapurāṇa*[3] as one of the fundamental properties of plants.

3. **Planting.**—The Science of planting is a very ancient science in India, and the origin of it is lost in obscurity, but a full-fledged development of it is mentioned in the Arthaśāstra[4] where a particular officer is referred to as the

[1] Adrishta (lit. unseen) stands for "unknown cause," or "unexplained Nature." Seal, page 133. (1915).

[2] Gough's Translation, p. 166.

[3] 3rd Skanda, Chap. X. 20. Srimat Sridhar Swami Krita Bhabarthadipika Tika Sametam. Calcutta, 1294 B.S.

"उत्स्रोतसस्तमः प्राया अन्तस्पर्शा विशेषिणः ।३।१०।२०।

(ऊर्द्ध स्रोतः—आहार सञ्चारो येषाम्)

[4] See Sec. 24, p. 138 (Shama Śastri).

Superintendent of Agriculture who must be "possessed of the knowledge of the science of agriculture dealing with the plantation of bushes and trees, or assisted by those who are trained in such sciences."

A typically nice description is contained in the following verses from *Brihat-samhitā*[1]:

"Let us first of all talk of the trees that should be planted in a garden or in the house itself: *Arishta* (Melia azadirachta) *Aśoka* (Saraca indica), *Punnāga* (Calophyllum inophyllum), *Śirīṣa* (Mimosa sirissa) with *Priyaṅgu* (Aglaia Roxburghiana) should be planted in the garden or in the house as pre-eminently conducive to the welfare (मङ्गल्याः) of the house." 3

Kāśyapa adds in addition *Champaka* (Michalia champaca), *Udumbara* (Ficus glomerata) and *Pārijātaka* (Erythrina indica), and they should be planted in "देवालये तथोद्याने गृहेषूपवनेषु च।".

The following verses from Agnipurāṇa[2] give us similar instructions with fuller details:

"It becomes conducive to the welfare of the house if *Plaksha* is planted towards the north of it, Banyan in the east, Mango in the south and *Aśwattha* in the west." 1

"Thorny bushes (कण्टकद्रुमाः) towards the south near the house are also good." 2

[1] Vrikshāyurvedādhyāya, Chap. 54. Vol. II, p. 743.

[2] Bibliotheca Indica, Vol. II, 1876, Chap. 281, pp. 42, 43.

"*Arishtāśoka*, *Punnāga*, *Sirīṣa*, *Priyaṅgu*, *Aśoka*, *Kadalī* (Plantain), *Jambu* (Blackberry), *Vakula* (Mimusops) and *Dāḍima* (Pomegranate) are to be planted in the garden adjoining one's house." 7

The following are the **essential preliminaries of plantation** :—

In Brihat-saṁhitā[1] :

"One should plant the tree after oneself being pure and after worshipping the tree with a bath and anointment, and the result will be that the tree will be graced with luxuriant growth of leaves." 8

"Uttarā, Rohiṇî, Anūrādhā, Chitrā, Mṛiga-sirā, Revatî, Mūlā, Viśākhā, Tishya, Śravaṇā, Aświnî and the Hastā—these are the stars under the influence of which a tree when planted will flourish." 31

In Agnipurāṇa[2] there are verses of similar import. Thus:

"One should take or plant the tree after worshipping the moon and Brahmin, and make sure to propitiate the five stars—Vāyavya, Hastā, Prājesha, Vaishṇava and Mūlā." 3 & 4

"One should perform the work (of plantation) after worshipping Varuṇa, Vishṇu and Parjjanya,—the rain God." 6

[1] See Chap. 54, Vol. II.

[2] See *Supra*, p. 37

Next comes the question—whether all parts, or different parts of a plant are to be planted in different seasons of a year? Varāhamihira in the Brihat-saṁhitā[1] directs:

"In the months of *Māgh* and *Falgoon* (शिशिरे) the trees whose branches and leaves are not developed (अजातशाखान्—अजात लताङ्कुरान् वृक्षान्); in the months of *Agrahāyaṇ* and *Pouṣ* (हेमन्ते) the plants with just-developed branches (जातशाखान्); in the months of *Śrāvaṇ* and *Bhādra* (वर्षागमे) plants with well-developed branches (सुस्कन्धान्)." Kāśyapa is more clear on the above directions:

"Plant in *Śiśira* those trees with undeveloped branches, in *Hemanta* those with developed branches according to prescribed rules (विधानतः) and those that are provided with well-developed branches (सुस्कन्धाः) during the *rains*."

Methods of plantations by **cuttings** and **graftings**:

In addition to the ordinary method of propagation by seeds the methods of propagation by *cuttings* and *graftings* were known from time immemorial, so much so, that the plants to which these methods can be applied are definitely named.

[1] See *Supra*, p. 37.

The following verses from Brihat-saṁhitā[1] distinctly name the plants and these methods:

"*Kānthāl* (Jack fruit tree), *Aśoka*, *Kadalī* (plantain), *Jambu*, *Lakoocha*, *Dāḍima*, *Drākshyā*, *Pālibata*, *Vījapura* (Mātulanga), *Atimuktaka*—these are the plants to be propagated by means of *cuttings* besmeared with cowdung (एते द्रुमाः काण्डरोप्या गोमयेन प्रलेपिताः)." 4 & 5

"Better than this method is the method of propagation by *graftings*. This can be done in two ways—the cuttings of one plant is either inserted on the root of another plant, or on the stem of another plant (मूलोच्छेदेऽथवास्कन्धेरोपणीयाः परं ततः)." 6

"Grafts should be smeared with cowdung. For transplanting (अन्यदेशे नीत्वा रोपयेदित्यर्थः) the plants should be smeared from root to the top (आमूलस्कन्धलिप्तानां) with ghee (clarified butter), sesame oil, the honey of the Khudra variety of the bee of the Ushira (Andropogon Laniger or Andropogon Citrarum), the *Viḍanga* (Embelica ribes) milk and cowdung." 7

What should be the **soil** for such plantation? The same author says:

"The most suitable ground to plant in is soft soil that has been sown with Sesamum

[1] Brihat-saṁhitā, Chap. 54, Vol. II, p. 743.

N.B—All the Ślokas are from the same Chapter—54 of the Brihat-saṁhita.

indicum and dug up and trodden with sesame in flower." 2.

Kāśyapa is more elaborate on the point:

"दूर्व्वावीरणसंयुक्ताः सानूपा मृदुमृत्तिकाः ।
तत्र वाप्यः शुभा वृक्षाः सुगन्धिफलशाखिनः ॥"

The **final direction** of planting is:

According to the same author—

" It is best to plant trees at intervals of 20 cubits, next at 16, and 12 cubits' interval is the minimum that can be prescribed. " 12.

Agnipurāṇa[1] has the same thing:

"It is best to plant trees at intervals of 20 cubits, an interval of 16 cubits is next, and worst is the interval of 12 cubits. Closely planted trees become fruitless (barren)." 8 & 9.

" The trees that are not at first planted after the Śāstric injunctions are destined to be fruitless."

And why this minimum limit? The answer is given in Sloka 13 of the same chapter of Brihatsaṁhitā. Thus:—" the roots thereby becoming mingled together will interfere with each other's function and will become ill at work, and fruits will not be produced (मिश्रैर्मूलैश्च न फलं सम्यग्यच्छन्ति पीड़िताः)."

After the trees are planted in the manner aforesaid "one should water them in the morning

[1] Agnipurāṇa, Chapter 281, Ślokas 8-9.

and evening in summer, at the end of the day in winter, and during the rainy season only when the earth is dried."[1]

4. **Manuring.**—The ancients had a pretty sure knowledge of the fact that the plants derive their food materials from the soil, and they had an excellent knowledge of the science of manuring. This is more elaborately dealt with in the Book of Agriculture.

The origin of manuring the soil can be traced as early as to a verse of the Atharva Veda.[2] The verse runs:

"With the straw of the brown, whitish, jointed barley for thee, with the sesame, stalk of sesame let the, etc., etc."

A more elaborate instruction in manuring is found in the Brihat Saṁhitā[3] and Agnipurāṇa,[4] in each of which a whole chapter is devoted to the purpose known as *Vrikshāyurveda.* Thus in Brihat Saṁhitā:

"To promote inflorescence and fructification, a mixture of one adhaka (64 palas) of sesame, two adhakas (128 palas) of excreta of goats or sheep, one prastha (16 palas) of barley powder, one tula (100 palas) of beef, thrown into one

[1] Brihat Saṁhitā, Śloka 9, Chap. 54.
Agnipurāṇa, Śloka 7, Chap. 281.

[2] A. V. II. 8. 3.

[3] Chap. LIV.

[4] Chap. 281.

droṇa (256 palas) of water, and standing over for 7 nights, should be poured round the roots of the plant. The measures given are for one plant."[1] This measure is for all kinds of plants (... वनस्पतेः। वल्लीगुल्मलतानां च फलपुष्पाय सर्व्वदा). 17 & 18.

Agnipurāṇa has almost precisely the same thing:

"To increase the production of flowers and fruits one should sprinkle ghee with cold milk, also a mixture of sesame, excreta of goats and sheep, barley powder and beef, thrown into water, and standing over for 7 nights should be poured round the roots of the plant." (गोमांसमुदकञ्चैव सप्तरात्रं निधापयेत्, etc.) 11 & 12.

Brihat Saṁhitā :

"To ensure inflorescence, etc. (कुसुमयुक्तमेव) the seed before being sown should be treated as follows:—The seeds should be taken up in the palm greased with ghee and thrown into milk ; on the day following the seeds should be taken out of the milk with greased fingers and the mass separated into single seeds. This process is to be repeated on 10 successive days. Then the seeds are to be carefully rubbed with cow-dung, and afterwards steamed in a vessel containing the flesh of hogs or deer. Then the seeds are to be sown with the flesh, with the

[1] Translation of these Slokas of the Brihat Saṁhitā are quoted from Dr. Seal's Positive Science of the Hindus.

fat of the hogs added in a soil previously prepared by being sown with sesame and dug up or trodden down"—and then to be sprinkled daily with water mixed with *kshīra* (क्षीर) 19 & 20.

"To ensure the growth of *Ballaris* (*i.e.*, sprouting and the growth of luxuriant stems and foliage)," Varāhamihira directs, " the seeds should be properly soaked in an infusion of powdered paddy, *Māsha* (Bean), *Sesame* and barley mixed with decomposing flesh, and then steamed with *Haridrā* (turmeric). This process will succeed even with the *Tintiḍi* (Tamarindus indica). For the *Kapittha* (Feronia elephantum) the seeds should be soaked for about 2 minutes (literally such length of time as it would take one to make a hundred rhythmic claps with the palms (तालशब्द:) in a decoction of eight roots : *Āsphota* (Jasmine), *Āmalakī* (Phyllanthus embellicus), *Dhaba* (Grislea tomentosa), *Vāsika* (Justica guaderussa), *Vetula* (Calamus rotung), *Suryyavallī* (Gynandropsis pentaphyla), *Shyāma* (Echites frutescens) and *Atimuktaka* (Aganosma caryophyllata) boiled in milk. The seeds then should be dried in the sun. This process should be repeated for 30 days. A circular hole should be dug in the ground, a cubit in diameter, and 2 cubits deep, and this should be filled with the milky decoction. When the hole dries up it should be burnt with fire and then pasted over with ashes mixed with ghee and honey. Three

inches of soil should now be thrown in, then the powder of bean, sesame and barley, then again three inches of soil. Finally washings of fish should be sprinkled and the mud should be beaten and reduced to a thick consistency, then the seed previously prepared should be placed in the hole under three inches of the soil and fish washings (with fish) poured. This will lead to luxuriant ramification and foliage which will excite wonder." 21, 22, 23, 24, 25 & 26.

The Agnipurāṇa[1] adds that the mango is specially benefited by cold fish washings (**मत्स्योदकेन शीतेन आम्राणां सेक इष्यते**). One can see this process is still resorted to in many mango gardens of Bengal.

Agnipurāṇa[2] also prescribes pouring of fish-washing as a general measure for luxuriant growth of trees (**मत्स्याम्भसा तु सेकेन वृद्धिर्भवति शाखिनः**).

The same idea of pouring fish-washings as a means of helping development of fruits is conveyed in one of the aphorisms of Khanā[3] which runs thus :

"Gourds flourish under the influence of fish washings."

Chakradatta in his Chikitsā-saṁgraha,[4] under section **वातव्याधि-चिकित्सा** (Treatment of

[1] Chap. 194, pp. 305 and 306 (Bengali Translation).

[2] Chap 281. 13.

[3] মাছের জলে লাউ বাড়ে, etc.

[4] Sloka 86, pp 293, 294, edited by Pyarimohan Sengupta, 129[?] B.S.

Rheumatism), gives a long recipe for the preparation of an oil, where it is said that when a dry barren tree is sprinkled with this oil (at the root) it becomes full of flowers and fruits, graceful and strong (...सूतेऽमुनाभूरुहा: । सिक्ता: शोषमुपागताश्च फलिन: स्निग्धाभवन्ति स्थिरा:).

In the next Sloka [1] he gives another recipe where he says that "if this oil be poured at the root of a dry tree it will sprout and bear flowers and fruits."

"Thus it will be seen that these elaborate recipes are empirical contrivances for supplying the plant with the requisite nitrogen compounds, phosphates, etc., these being potentially contained in the mixtures and infusions prescribed." (Seal).

As to the **rotation of crops**—in the same field two crops were used to be grown—rice in summer and pulses in winter. Rotation of crops was thus known, and "to India Dr. Roxburgh believes the Western world to be indebted for this system." [2]

5. **Treatment of plants.**—The science of the treatment of plants (*Vrikshāyurveda*) which

[1] Sloka 87.

"अनेनैव च तैलेन शुष्यमाना महाद्रुमा: ।
सिक्ता: पुन: प्ररोहन्ति भवन्ति फलशालिन: ॥

[2] Mrs. Spier, Life in Ancient India, Chap. VII, p. 151, London 1856 *Cf.* also Fragment XI—Fragments of Indika of Megasthenes, Bonn, 1846.

does not yet technically exist in the West is represented by a regular section of the monumental work of Varāhamihir [1] as well as one in Agnipurāṇa.[2] The chapter entitled the "*Vrikshāyurveda*" or the science of treatment of plants in disease denotes elaborate care.

Guṇaratna in his commentary [3] writes—"Just as the human body is subject to jaundice, dropsy, shofa (?), emaciation and defects (dwarfness) of finger, nose, etc., etc., so also plants suffer from similar diseases such as inception of disease, displacement or dislocation of flower, fruit, leaves, bark."

"And just as by the application of the appropriate remedies unnatural growth, deterioration, wounds, fructures, etc., can be cured, so also in plants by application of proper drugs as prescribed in *Vrikshāyurveda*."

Śaṅkara Miśra [4] also in his Upāskara notices 'application of drugs' in plants (भेषजप्रयोग).

Varāhamihir [5] gives the following **signs** of the diseased condition of plants (एतैस्त्रिभिस्तरुः सरोगो ज्ञेयः) :

"Cold climate (low temperature), wind (dryness) and sun (high temperature) are the

[1] Brihat-saṁhita, Chap. 54.
[2] Agnipurāṇa, Chap. 281.
[3] Bibliotheca Indica, New Series, 1151 (1907).
[4] On Vaiseshika Philosophy, 4-2-5
[5] Chap. 54, Vol, II.

causes of disease. (When the plant is diseased) the leaves become yellow (etiolated), buds (प्रवालानां) do not develop or their growth arrested, branches become dry and the sap (*rasa*) exudes." 14.

Kaśyapa says "those plants that have yellow leaves (पाण्डुरैः पत्रैश्च), that are fruitless and denuded of leaves and these caused by coldness, excessive heat, too much rain, dry wind and by the intermingling of roots of different plants are to be known as diseased, and are to be treated accordingly."

Treatment.—Remedies are prescribed both preventive and curative.

As a general **prophylactic** Varāhamihir says:

"As a sort of general prophylactic mud kneaded with ghee and *Viḍanga* should be applied to the roots, after which milk diluted with water should be poured." 15.

In the Agnipurāṇa remedies are given almost to the same effect :—"*Viḍanga* mixed with rice, fish and flesh—all these mixed together constitute a remedy invigorating to the plants and curative of their diseases." 13.

Turning to **curative**: A cure is prescribed for that most incurable of diseases—barrenness. Varāhamihir prescribes—"As a remedy against barrenness a hot decoction should be made of *Kulattha* (Dolichos biflorus), *Māsha* (Phaseolus mungo var Roxburghii), *Mudga* (Ph. radiatus),

Tila (Sesamum indicum) and *Yava* (Barley) which when cooled should be poured round the roots." 16 & 20.

Almost an identical recipe occurs in the Agnipurāṇa—" *Viḍanga* and ghee kneaded with mud and sprinkled with cold water together with *Kulattha*, *Māsha*, *Mungo*, *Yava* and *Tila* should be used in a case of barrenness (फलनाशे)." 10.

6. **Respiration.**—Respiration in plants in the modern sense was perhaps unknown to the ancient Indians. But the injurious effects of carbon dioxide (a gas given out by the plants during respiration) seems to be not unknown to them, a fact which is evident from an injunction of Manu.[1] Thus :

"One should not stay (sleep) during night hours under a tree, nor pass under it."

7. **Movements.**—Irritability. The phenomena of the movements of plants, their capacity for sleep, their sensitiveness to touch (contact), heat, wind, noise (thunder), etc., were noticed long ago.

In the Mahābhārata, Śāntiparva,[2] we get an account of the sensitiveness of plants to touch, heat, thunder, etc.

The Buddhist Scholiast Dharmottara in his Nyāyavindu Tika[3] notices the phenomenon of

[1] Manusaṁhitā, IV, 73.

[2] Chap. 184.

[3] Bibliotheca Indica, Chap. II, 23, edited by P. Peterson, 1889.

sleep—contraction of leaves in the night (स्वापः रात्रौ पत्रसङ्कोचः) in certain plants (नहि सर्व्वे वृक्षाः).

Udayāna in his Kiraṇāvalī,[1] in a chapter named पृथिवीनिरूपणम् (*Prithivīnirūpaṇam*), notices in plants "the phenomena of life, death, sleep, waking, disease, drugging, transmission of specific characters by means of ova, *movements* towards what is favourable and avoiding what is unfavourable." (इत्थं प्रतिनियत-भोक्त्रधिष्ठिताः जीवन-मरणस्वप्नजागरणरोगभेषजप्रयोग-सजातीयानुविद्धानुकूलोपगम-प्रतिकूलोपगमादिभ्यः । प्रसिद्धशरीरवत्).

Guṇaratna in his commentary[2] enumerates the following characteristics of plant life:—Various kinds of movements or actions connected with sleep, waking, expansion, and contraction in response to touch, also movements towards a support or prop.

Guṇaratna also gives a list of plants that exhibit the phenomena of Sleep and Waking. He also notices the sensitiveness to touch of plants like the Mimosa pudica (लज्जावती—hence the name) which show a manifest reaction in the form of contraction. (लज्जालुप्रभृतीनां हस्तादि-संस्पर्शात् पत्रसंकोचादिका.)

He also notices that Nelumbium speciosum (lotus) opens with the sunrise; *Ghoshātaki* (Luffa amara or acutangula) and others in the

[1] Bibliotheca Indica, New Series, 1342 (1912), Fasc. III, pp. 238-244.

[2] Bibliotheca Indica, New Series, 1151 (1907), Sloka 49, p. 157.

evening and Lily with the rise of moon. "पद्मादीनां प्रातर्विकसनं, घोषात्यकादिपुष्पानां च संध्यायां, कुमुदादीनां तु चन्द्रोदये ।"

Śaṅkara Miśra in his Upāskara[1] also notices plants as characterised by "approaching the agreeable and avoiding the disagreeable," etc. "सजातीयानुबन्धानुकूलोपगम-प्रतिकूलोपगमः सम्भवति ।"

In this connexion we might mention that the name 'Sūryyamukhî' (Sunflower) for the particular plant—a flower which always faces the rising sun—is significant.

8. **Growth.**—The stages of growth in plant life are very briefly but comprehensively noted by Guṇaratna in his commentary. Thus:

(1) Stages of infancy, youth and age. (बाल-कुमार-युव-वृद्धता-परिणामः.)

(2) Regular growth—"Just as man experiences the stages of infancy, adolescence, youth and old age thereby demonstrating full consciousness, so also do trees." "And just as the human system undergoes constant growth through the stages of infancy, adolescence, youth, etc., likewise a tree undergoes growth through stages of sprouting, seedling with new leaves, branching and so forth." "वनस्पतिशरीर-मरकिङ्कसलय-शाखाप्रशाखादिभिर्विशेषैः प्रतिनियतं वर्द्धते इति ।"

The conditions of growth seem to be not unknown to the ancient Indians. Thus:

[1] S. B. H., Vol. IV, and Gough's Translation and Edition, 4. 2. 5.

(1) *Food*—The same Commentator mentions growth or decay by assimilation of suitable or unsuitable food.

(2) *Water*—(भूजलाद्याहार, etc.). The necessity of water as a condition of growth (बलं) of plants is emphasized by the mythical prophetess Khanā—"Light by day and water by night—these two lead to the growth of strength to plants."

(3) *Light*—as a factor for healthy growth is also mentioned. Light as a general rule retards growth, absence of light or shade accelerates it. The following aphorism of Khanā[1] very tersely puts the truth:

"*Ol* (Amorphophallus campanulatus) grown in a shady place, *i.e.*, in the absence of direct sunlight causes irritation in the mouth, but it is not to be regretted," for what is lost in quality is gained in quantity, *i.e.*, *Ol* grows in volume in shade which is economically the more important.

"Betel leaf in shade and paddy in sunlight"[2] also testifies the same truth.

But for healthy growth light is necessary is clear from the aphorism already quoted under factor 'water.'

9. **Age and Death.**—The marvellous longevity attained by plants is also referred to by

[1] "ছায়ার ওলে চুলকায় মুখ, কিন্তু তাহে নাহি দুখ"।

[2] "ছায়ায় পান, রোদে ধান"।

Guṇaratna, in his commentary[1] to the extent of a maximum of ten thousand years (दशसहस्रा-ण्युत्कृष्टमायुः).

He also mentions the causes of death, such as assimilation of suitable and unsuitable (इष्टा-निष्टाहारादिप्राप्ता) food, also disease.

Udayāna also notices in his Kiraṇāvalî[2] death, disease, drugging, etc., in plants. (जीवनमरणस्वप्न-जागरण-रोगभेषजप्रयोग, etc.)

So also in Upāskara[3] (जीवनमरण, etc.)

10. **Consciousness in Plants.**—The phenomenon of consciousness in plants was well known to the ancient Hindus, and throughout the whole of their literature we find scattered references unmistakably bearing testimony to this knowledge. In popular superstition as well as in profound speculation we meet with this testimony. The popular notion of Vriksha-Devatā or presiding deities of trees corresponding to the Dryads of the Greeks is a matter of common knowledge. Some of the Jātakas which are systematised popular stories relating to Buddha, mention the Bodhi-Sattwa born as Tree-spirit for 33 times. And the grammatical treatise like Kalāpa referred to this prevalent

[1] Bibliotheca Indica, New Series, 1151 (1907), pp. 157, 158.

[2] Bibliotheca Indica, New Series, 1342 (1912), Fasc. III, pp. 238, 239, etc.

[3] Sacred Book of the Hindus Series, Vol. VI, pp. 159-60. (Panini office.) Also A. E. Gough's translation, Benares, 1873, pp. 147-148.

popular belief as to the trees being animated by spirits.

Coming from popular belief to profound speculation we meet with precisely the same thing. A verse in the Rigveda[1] is addressed to the plants evidently referring to their possession of the gift of hearing. The practice is repeated both in the Rig and the Atharva[2] Vedas.

Mahīdās Aitareya[3] includes the herbs and trees along with animals in the organic world. According to him plants belong to the last of the four classes of beings, *i.e.*, propagated from germs. In his theory of the gradual development of the soul he says, "In herbs and trees, for example, Sap (life) only is seen, but thought (Chitta) in the widest sense is in the higher forms of life." In another place of his Book (I. 2. 4. 14) he says, "all forms of life eat and drink. All lower animals propagate the species. Even the plants when they are grown up, bear fruits."

Uddālaka says that "the living principle is the potentiality of living bodies—the real seed of things. It is, for example, that potentiality

[1] Rigveda, X, 97. 21

[2] Atharva Veda, XI, 6 10. "In obedience to the thundering voice of the vital breath (prāṇa) that the plants are fecundated, that they conceive and multiply." Dr. Barua's History of Pre-Buddhistic Indian Philosophy, I, p 25, 1921.

[3] Aitareya Āraṇyaka, I, 5. 1. 9. ; II. 6. 1. 5.—Barua, IV, pp. 57, 58.

or vitality in an infinitesimally small seed from which a large Banyan tree springs into existence. It is the spirit which animates all the parts of a living being. When this spirit leaves any branch of a tree, that withers, *i.e.*, ceases to be an integral part of the living whole, when it leaves another branch, that too withers. And when in this way it leaves finally the whole tree withers and perishes. But the living principle never dies."[1]

The Manu Saṁhitā[2] distinctly states that the trees are trees on account of their being under the influence of *tamóguṇa* (तमोगुणः), but they "possess a sort of dormant or latent consciousness, and are capable of pleasure and pain." (अन्तःसंज्ञा भवन्त्येते सुखदुःखसमन्विताः).

According to Maskarin Gosāla[3] "the plant life or vegetable kingdom, like the elemental life, is possessed of only one sense, the sense of touch. But Gosāla admits that plants in general stand higher in the scale than elemental lives."

There is a lengthy, philosophical or rather an analytical exposition of the theme of consciousness in plants in the Mahābhārata, Śāntiparva.[4]

[1] Chhāndogya Upanishad, VI. 12. 1 2 Barua, *ibid*, VIII, pp. 136-137.

[2] Manu, 1. 49.

[3] Barua, *ibid*, XXI, p. 308.

[4] Śāntiparva, 184th Chapter, p. 855. Kāliprasanna Singha's Translation, Basumati Edition.

1397/

"Brahman," interrogated Bharadwāj, "if bodies both moving and unmoving, are made up of five elements, why do we not then perceive their existence in the immovables? Plants and creepers, can neither hear, nor see or smell, taste or touch. Nor are there in them liquids like blood, the elements of fire (energy), earth represented by bone and marrow, the element of air represented by activity, and the sky (ether) represented by empty space (pore). How then, can they be regarded as constituted of five elements?"

"Brahman," replied Bhrigu, "we cannot indeed perceive the existence of Ether in them through the naked eye because they are solid (घनीभूत), but when we ponder over the fact how they constantly produce fruits and flowers this existence becomes manifest to us. How can we doubt the existence of their *gift of touch* seeing that their leaves, bark, fruit and flowers wither under the influence of heat? We must infer the *gift of hearing* in them seeing that their fruits and flowers dry up under the influence of wind, fire and the sound of thunder. Eyeless creatures can never go their way of themselves, and as creepers approach and wind round the trees and move at will, we must admit the existence of *sight* in them. And as they can be healed of their diseases by the application of odour both pleasant and unpleasant

and also by frankincense of various types, it is sure that they possess the *power of sense.* The *organ of taste* in them must be inferred from the fact that they are capable of drinking water through the root. As we suck up water through a lotus stalk applied to the mouth so do plants with the help of air drink up water through their roots. Thus as they are found to be sensitive to pleasure and pain, and as they are seen to undergo regeneration after mutilation, we must admit the existence of *life* in them. Fire (energy) and air (CO_2) help in the assimilation of the water that unmoving beings like trees take up (from the soil) through the roots."

Udayāna[1] also notes "that plants have a dormant unmanifested consciousness which is extremely dull" (अतिमन्दान्तःसञ्ज्ञितया, etc).

Guṇaratna[2] in his commentary refers distinctly to the consciousness of plants as a point of similarity between plants and man (अतः पुरुषशरीरतुल्यत्वात् सचेतनो वनस्पतिरिति). He then elaborates his remarks.

Upaskāra[3] commenting on Kaṇāda's aphorism (4.2.5) refers to plants as being the "ground of experience of the consequences of acts." Thus—"Trees and the like also are no doubt

[1] Bibliotheca Indica, New Series, 1342 (1912), Fasc. III, pp. 238-244.
[2] Bibliotheca Indica, New Series, 1151 (1907).
[3] S.B.H., Vol.VI, Panini Office.

so many kinds of bodies, being the seat of experience (*i.e.*, the field wherein particular souls reap the consequences of their acts in previous births). For without the characteristic of being the seat of experience, life, death, sleep, waking, use of medicine, propagation of the seed, approaching agreeable, avoiding the disagreeable, etc., would be impossible."

The Bhāgabat Purāṇa[1] very definitely points out the following peculiarities of plants (तेषां साधारणं लक्षणमाह) :

(1) their process of taking of food from below upwards (उत्स्रोतसः).

(2) dormant consciousness (तमःप्राया अव्यक्तचैतन्याः), and

(3) the possession of the sensation of touch (अन्तःस्पर्शाः).

"Chakrapāṇi notes in the Bhānumati that the consciousness of plants is a sort of stupefied (darkened or comatose) consciousness (वृक्षास्तु चेतनावन्तोऽपि तमसाच्छन्नज्ञानतया शास्त्रोपदेशाविषया एव)."[2]

11. **Sexuality.**—The idea of sexuality in plants as entertained by the ancients in India is highly quaint but vague and inaccurate, being the result not of scientific observation but of pure poetic speculation from start to finish. The general idea of the division of the

[1] 3rd Skanda, 10th Chap., Slokas 19, 20, p. 30, with Sridhar Swami's Commentary, Calcutta, 1294 B.S.

[2] Dr. Seal, Positive Science, p. 175.

plant kingdom into male and female based on human analogy was formed. Thus Hārīta Saṁhitā [1] records possibly the earliest fanciful division :—

"Hārīta asks :

'Why, O sage, is there no conception without the union? Or, why are there no flowers and fruits produced without the union (of the sexes)? Why is the same kind of fruition not to be perceived in women as in the plants?'

Ātreya said :

'The seed, O son, is produc co
operation of different sexes ar in
and the fixed plants, its qualit
to the sperm (धातु).

" No two opinions exist
my son, among the fixed p
ed with *śiva* and *śakt*

[1] Śārīrasthāna, Chap. I, p. 344. Śakābda 1807.

हारीत उवाच—संयोगेन विना प्राप्त
संयोगेन विना पुष्पं
वृक्षवन्न कथं स्त्रीणां
आत्रेय उवाच—विरुद्धानाञ्च वर्ण
तत्र धातुसमं बी
न भिन्नदृष्टितरे
स्थावराणाञ्च स
निश्चलोऽपि ि
तत्र स्त्रीपुरु
आम्रपुष्पं फ

the female procreative energies, know this. That which has static (निश्चलोऽपि) property is to be known as *śiva*, the male, and that which has dynamic property (व्याप्तिशक्ति) is to be known, O the great-souled one, as *śakti*, the female. The functions of the male and the female arise from their combination. The ma.. o flowers, fruits and stones (embryo within) likew. .e are endowed with *śukra*, the generating po .er."

Chara. a[1] is more clear, though not at all mc ntific than Hārīta on this point. In c he description of properties, etc., of V hena antidysenterica) Charaka ... the *Vatsaka* which bears ... fruits, and tender (स्निग्धः) ... e category of males ; and ... l and yellow flowers and ... lk and whose colour is ... gory of females.

... ndu knowledge in this ... urther, as we get in ... assification of plants ... neuter based on the ... as slenderness or

... engali Edition of D. N.
... नपुष्पः पुमान्, श्यामारूपाणु-
... English Translation—

स्त्रीपुंनपुंसकत्वेन वैविध्यं

stoutness, softness or hardness, length or shortness, simplicity or complexity of the character of the stem and flowers.

The famous lexicon of Amara[1] represents observation as going a bit further, but he gives us the very reverse of scientific truth. He confounds the pollens of flowers as corresponding to the female menstruum.

Pliny,[2] the foreign observer, mentions—"The Indians tell us that in these plants (Indian Reeds—perhaps Palmyra or Date-palm is meant) also the distinction of male and female obtains, the body of the male being more compact, and that of the female of greater amplitude."

Curiously enough in one case[3] we get the differentiation of sexes in plants based on actual observation. This is the instance of *Ketakī* (Pandanus odoratissimus). This plant is always mentioned as a couple (केतकीद्वयम्) ; the male one being designated as *Sitaketakī* and the female one as *Svarṇaketakī*. That the former is a male is emphasised by the author of Bhābaprakāś by calling it *Ketaka* (केतकः). Rājanighaṇṭu describes *Sitaketakī* (male) as *Biphalā*—not producing fruits ; *Dhūlipushpikā*—having flowers with dusts, *i.e.*, with only pollen grains (microspores). Dhanvantarī Nighaṇṭu has

[1] Vanaushadhi Varga. 50. स्त्रीणां सुमनसां पुष्पं प्रसूनं समम् ।
[2] McCrindle, Ancient India, Sec. V, 1901.
Vanaushadhi Darpaṇa, Vol. I, pp. 222-223, Calcutta, 1908.

described *Svarṇaketakī* (female) as *Kanaka-prasavā*—yielding a golden harvest, *Sugandhinī* (sweet-scented), etc.

12. **Reproduction.**—Various methods of propagation of plants such as by fruits and seeds (*vījarūha*), by roots (*mūlaja*), by cuttings (*skandhaja*), by graftings (स्कन्धे रोपणीया), by *agravīja* (apical portions), by *parṇayoni* (leaves) and *saunarudhaja* (?) are mentioned in ancient treatises.

Propagation by seeds (*Vījarūha*) is a very common method which has been known to the Hindus from the very earliest times. The Rigveda refers to it, the Atharva Veda mentions it in various places. Manu[1] has also mentioned it.—" Some of these plants grow from seeds and some from planted cuttings."

Propagation by bulbous roots and underground stems (*Kandavījam*) has been an equally common method. A distinct mention of the method is found in the Arthaśāstra[2] where the following rule is laid down:—"Seeds of bulbous roots (*Kandavīja*) with honey and clarified butter are to be smeared with before planting."

Cutting (*Skandhavījam*) is another method resorted to for the purpose of propagation. Manu[1] mentions it. The process is very well described in the Arthaśāstra[2] and

[1] Manu, I, 46, 48.

[2] Arthaśāstra, Chap. 24, p. 141. Shama Sastri's English Translation

Brihat-saṁhitā[1] of Varāhamihir. The former prescribes that the "seeds of sugarcane and the like are (to be) plastered at the cut end with the mixture of honey, clarified butter, the fat of hogs, and cow dung" before being planted.

Brihat-saṁhitā enjoins that *Kānthāl* (Jack fruit), *Aśoka* (Saraca indica), *Kadalī* (Plantain), *Jambu* (Blackberry), *Lakucha* (Artocarpus lacoocha), *Dāḍima* (Pomegranate), *Drāksha* (Vine), *Pālibata*, *Vijapura* (Lemon tree) and *Atimuktaka* —all these are to be planted by means of cuttings (काण्डरोप्याः). The cuttings are to be besmeared with cowdung and then planted. 4 & 5.

Maskarin Gosāla[2] mentions "sugarcane, bamboo, reeds, etc., propagate from joints."

Better (परं) than cuttings is the process of grafting as recommended by the author of Brihat-saṁhitā. There are two methods:—one consisting in inserting the cutting from one plant into the root of another severed from its trunk. And the second method consists in inserting the cutting of one tree into the stem of another—the cutting is called the scion and the parent plant is called the stock. 5.

Another method is mentioned as *Agravīja*, *i.e.*, plants whose apices are only planted as a means of propagation—Betel is propagated in

[1] Brihat-saṁhitā, Chap. 54, Vol. II, p. 743.

[2] Barua, XXI, p. 306.

this way. This may also mean propagation from "buddings" (see below).

Then there is the method known as *Parṇa-yoni*, *i.e.*, leaves serving as a means of multiplication. The present common example of this method of propagation is found in Bryophyllum calycinum and in Begonias.

Lastly, a method—the method of self-layering is described by Onesikritos[1] thus—"... there are some large trees from which branches grow out to the length even of 12 cubits. These branches then grow downwards, as if they had been bent until they touch the ground. They next penetrate into the soil and take root like shoots that have been planted. Then they spring upwards and forms a trunk." Pliny[2] also mentions this kind of propagation with regard to the Indian Fig tree.

That these various methods of propagation of plants were a common knowledge in India will also appear from a dialogue of the Buddha[3] in which the following remarks occur:

"Whereas some recluses and Brahmans, while living on food provided by the faithful, continue addicted to the injury of seedlings and growing plants whether propagated from *roots*,

[1] McCrindle, Ancient India, Sec. 21 (1901).

[2] Book XII. C. (11).

[3] Dialogues of the Buddha, Part I,—Brahma Jāla Sutta 11. Sacred Books of the Buddhists Series, Vol. II, pp. 6, 7 (Rhys Davids).

or *cuttings* or *joints* or *buddings* or *seeds*—Gôtama the recluse holds aloof from such injury to seedlings and growing plants."

Buddha Ghosha[1] in his comment upon the passage gives us illustrations of the methods of propagation mentioned above. Thus:

Mūla-bījam (root-seeds)—*Haliddiṃ* (Turmeric), *Singiveraṃ* (Zingiber), *Vacaṃ* (Acorus calamus), *Ativisaṃ* (Aconitum heterophyllum), *Kaṭukarohiṇī* (Picrorrhiza kurroa), *Usīraṃ* (Andropogon muricatus), etc.

Khanda-bījam (cuttings)—*Assattho* (Ficus religiosa), *Kacchako* (Cedrela toona), *Nigrodha* (Ficus bengalensis), *Pilakkho* (Ficus infectoria), *Udumbaro* (F. glomerata), *Kapitthano* (Feronia elephantum), etc.

Phaḷu-bījam (joints)—as in Reed.

Agga-bījam (buddings)—the plant *Samirana*, *Ajjukam* (Ocimum basilicum), *Hiriveram* (Andropogon cynanthus), etc.

Bīja-bījam—(seeds)—*Pubbaṇṇaṃ* (7 dhanyas—paddy), *Apparaṇṇam* (Pulses, Cucurbita, etc.).

[1] The Sumaṅgala-Vilāsinī—Buddha Ghosha's commentary on the Dīghanikāya. Edited by Rhys Davids and Carpenter, P.T.S., Part 1, p. 81. D.I. 1 11.

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SECIION VI

ECOLOGY: OR STUDY OF PLANTS IN THEIR NATURAL HOMES.

Charaka[1] divides land into different regions according to the nature of the soil (edaphic conditions) and climate (climatic conditions) that determine the characteristic vegetation, and also mentions some of the plants characteristic of each region. Thus he divides land into :

(1) **Jāngala region**—(literally, dry wilderness-deserts ; plants—*Xerophytes*).

(2) **Anūpa region** (literally, abounding in water; plants—aquatic (*Hydrophytes*) and marshy (*Hygrophytes*).

(3) **Sādhāraṇa region**—(ordinary ; plants—*Mesophytes*).

1. **Jāngala region.**—"The region called *Jāngala* is full of unobstructed open spaces, where a steady and dry wind blows, pervaded with expansive mirages ; rivers and rivulets scarce, abounding in well (scarcity of water) also abounding with dry and rough sands and big sandy particles (*kankurs*)." [1] 6 & 7.

[1] Charaka, Kalpasthāna I. Madanaphala Kalpa, 6, 7 and 9 (verses). For English Translation, see Fasc. LXI, Kalpasthāna, Lesson 1, pp. 1917, 1918 (English Translation).

Suśruta[1] describes this region as : "the country which presents a flat surface, and whose dull monotony is enlivened here and there by scanty growths of thorny shrubs, and tops of a few isolated hills and knolls, and in which the waters from springs and wells, accumulated during the rains, become nearly drained, and strong gales of warm wind blow (during the greater part of the year)." 35.

According to *Charaka* the following are the plants that grow in this region: *Khadira* (Acacia catechu), *Asana* (Pentaptera tomentosa), *Aśvakarṇa* (a variety of Shorea robusta), *Dhava* (Conocarpus latifolia), *Tinisha* (Dalbergia oojeinensis), *Śallakī* (Boswellia serrata), *Sāla* (Shorea robusta), *Somavalka* (Acacia arabica), *Vadarī* (Zizyphus jujuba), *Tinduka* (Diospyros glutinosa), *Aśwattha* (Ficus religiosa), *Vata* (F. bengalensis) and *Āmlakí* (Phyllanthus emblica). The predominant types of trees are : *Samí* (Mimosa sumo), *Arjuna* (Pentaptera arjuna) and *Siṁśapā* (Dalbergia sisoo)—these are all xerophytic. 6 & 7.

2. **Anūpa region.**—(Marshy or swampy and watery.)

Swampy—" mostly abounding in rivers and bordered by seas, swept by cold wind, *i.e*, charged with abundant moisture. The country

[1] Sūtrasthāna, Chap. 35, verses 34-42. For English Translation, see Vol. II, pp. 325-26.

is interspersed with rivers, banks of which are decked with—*Vañjula* (Calamus rotung) and *Vānīra* (Calamus Roxburghii of the aquatic variety). Mountains are absent from this region. The region is thickly overgrown with forests, bowers and trees in flowers encircled by verdant trees and tender creepers.

The land is covered with dense forests of *Hintāla* (Phœnix paludosa), *Tāla* (Borasus flabelliformis), *Tamāla* (Cinnamomum tamala), *Nārikela* (Cocos nucifera) and *Kadali* (Musa sapientum).—*Charaka*. 8.

Suśruta describes this region as the country "that contains a large number of pools, and is wooded and undulated with chains of lofty hills traversing its area, and which is impassable owing to its networks of rivers and sheets of accumulated rain water rippling before the currents of the gentle, humid air." 34.

Varāhamihir[1] mentions the following trees as growing in *Anūpa* region :—*Jambu* (Eugenia jambolana), *Vetasa* (Calamus rotung), *Vānīra* (Calamus sp.), *Kadamba* (Anthocephalus cadamba), *Udumbara* (Ficus glomerata), *Arjuna* (Terminalia arjuna), *Vijapuraka* (Citrus medica), *Drākśhā* (Vines), *Lakucha* (Artocarpus lakoocha), *Dāḍima* (Pomegranate), *Vañjula* (Calamus sp.), *Naktamāla* (Caesalpinia bonducella), *Tilaka* (Sesame), *Panasa* (Jack fruit), *Timira* (?),

[1] Chap. 54, Vol. II, p. 745.

Āmrātaka (Spondias mangifera),—these 16 kinds of trees are the predominant species of this region." 10 & 11.

Aquatic plants (*Hydrophytes*)—

Amara[1] mentions the following plants as growing exclusively in water :—

Saugandhika, Kalhāra ...	White water-lily.
Hallaka, Raktasandhyakā	Red variety.
Utpala, Kubalaya ...	Any other water-lily.
Indīvara ...	A blue one.
Kumuda ...	Nymphæa lotus (esculent white sort).
Padma, Kamala ...	Nelumbium speciosum (lotus).
Puṇḍarīka, Sitāmbhoja ...	A white lotus.
Kokanada, Raktotpala ..	A red lotus.
Vāriparṇi ...	Pistia stratiotes.
Mushākarṇí ...	Azolla, Salvinia.
Jalanīlí, Śaivāla ...	Vallisnaria, and the green algae.

3. **Sādhāraṇa**—or the ordinary.—*Charaka* says—"That region which is endued with creepers, and plants and trees of both the classes, *i.e.*, the *Vanaspati* and *Vānaspatya*, is called *Sādhāraṇa*. 9.

According to *Suśruta* a country which exhibited features common to both the aforesaid classes is called *Sādhāraṇa* or ordinary." 36.

[1] Amarakosha, Pātālavarga 50-56. *Cf.* Colebrooke's Edition (1807). Book I, Chap 2, Section 3, Aquatic Plants, 36-42.

In the *Swargavarga* of *Amarakosha* the following trees—*Māndāra*, *Pārijātaka*, *Santāna*, *Kalpavriksha* and *Harichandana* are mentioned as five celestial ones; and they seem to be *alpine* (mountainous) trees, as according to Hindu mythology Heaven or the abode of gods, is situated at the top of the Himalayas.

Plant Association.—In some places plants of a particular species predominate over others, and the place is given the name of the species dominating there to the exclusion of others. Such as[1]:

Kumudvatī, *Kumudinī*—the place where white water-lilies predominate; place abounding in lotus is called *Padminī*, *Nalinī*; where reeds abound it is called *Nadvat*, *Nadvala*; one abounding in ratans is called *Vetaswān*, in green grasses *Śādvala* (शाद्वलः).

Even rivers abounding in particular species are known by the species dominating—such as *Śarāvatī* abounding in *śara* (reeds) and *Vetravatī* abounding in *Vetra* (ratans).

The names *Kuśadwīpa*, *Plakshadwīpa*, *Śālmalīdwīpa*, etc., for the different islands in the Purāṇas, may be indicative of places where these particular plants—*Kuśa* (Poa cynosuroides), *Plaksha* (Ficus infectoria), *Sālmalī* (Bombax malabaricum), etc., predominated.

[1] Amara, *Pātāla* and *Bhūmi Vargas* (9 and 10).

SECTION VII

TAXONOMY

1. **Nomenclature.**—The naming of plants constitutes a highly interesting topic, full of historical and cultural significance, showing us at once a good deal of the accurate knowledge of the geography of India, and throwing an interesting sidelight upon the brisk intercourse among the different parts of India, and giving us unmistakable proofs of the power of scientific observation.

In the second volume[1] of his "Botanical Observation on Select Indian Plants" Sir William Jones, the President-Founder of the Asiatic Society, Bengal, writes—

"I am very solicitous to give Indian plants their true Indian appellations, because I am fully persuaded that Linnaeus himself would have adopted them had he known the learned and ancient language of this country, etc."

The plants[2] have been named according to—

A. **Special association:**

(*i*) *Bodhi-druma* (Ficus religiosa)—so called after Buddha's attaining nirvāṇa under it.

[1] A Review, XXXIII.

[2] Only a few examples under each are given as illustration.

(*ii*) *Aśoka* (Saraca indica)—so called after legendary association with Aśoka forest in which Sītā, that pink of chastity, was confined.

(*iii*) *Śiraśekhara* (Datura)—as the flower is associated with Śiva, the Indian god of destruction.

(*iv*) *Yagñadumura* (F. glomerata)—associated with sacrifice—*Homa*.

B. **Special property:**

(*a*) *Medicinal*:

(*i*) *Dadrughna* (Cassia fistula)—that which cures ring-worm.

(*ii*) *Arśoghna* (Amorphophallus campanulatus)—that which destroys piles.

(*iii*) *Śothaghna* (Boerhavia repens)—that which destroys dropsy—œdema.

(*iv*) *Abyathā* (Myrobalan haritakī)—that which takes away pain.

(*v*) *Kusthanāśinī* (Somaraji)—that which cures leprosy (skin disease).

(*vi*) *Lodhra* (Symphlocos racemosa)—that which stops ocular discharge.

(*b*) *Domestic utility*:

(*i*) *Vānīra* (Cane)—it is desired for making houses.

(*ii*) *Dantadhābana* (Acacia catechu)—required for cleansing the teeth.

(*iii*) *Kārpāsa* (Cotton)—that out of which clothes are weaved.

(*iv*) *Dhanudruma* (Bambusa)—that out of which bows are made.

(*v*) *Lekhana* (Reed)—from which *lekhanī* (pens) are made.

(*vi*) *Agnimantha*—(Premna spinosa or serratifolia)—gathered for kindling fire.

C. **Special characteristic features:**

(*i*) *Phenila* (Soap berry)—its seeds give lather or foam with water.

(*ii*) *Bahūpāda* (Ficus bengalensis)—many legged—with prop or pendent roots serving as so many legs.

(*iii*) *Sitisāra* (Diospiros sp.—a sort of ebony)—black is its wood.

(*iv*) *Ātmagupta* (Dolichos pruriens)—self-protected fruits having been provided with spiny hairs, also highly poisonous.

(*v*) *Charmin* (Bhojapatra)—with wide *charma* (bark).

D. **Special morphological features:**

(*a*) *According to the number of leaflets in the compound leaf:*

(*i*) *Dwipatra* (Bauhinia)—evidently wrong.

(*ii*) *Tripatra* (Wood apple)—with three leaflets.

(*iii*) *Saptaparṇa* (Echites scholaris)—with seven leaflets.

(*b*) *Nature or shape of leaf*:

(*i*) *Dirghapatraka* (Cane-ratan)—with very long leaves.

(*ii*) *Kīśaparṇī* (Achyranthes sp.)—leaves having the shape of the ear of a monkey.

(*iii*) *Mūṣikaparṇī* (Salvinia)—whose leaves resemble the shape of the ear of a mice.

(*iv*) *Aśvaparṇaka* (a variety of Shorea robusta)—leaves resemble the shape of the ear of a horse.

(*v*) *Pañchāṅgula* (Ricinus)—with palmate and five-ribbed leaves.

(*vi*) *Kaṇṭakapatrikā* (Brinjal)—having prickly leaves.

(*c*) *Shape and colour of flowers* :

(*i*) *Vakrāpuṣpa* (Sesbania grandiflora)—with papilionaceous flowers.

(*ii*) *Hemapuṣpa* (Michelia champaca)—flowers having the colour of gold.

(*d*) *Miscellaneous* :

(*i*) *Śatamūlī* (Asparagus)—with hundred roots (many).

(*ii*) *Śataparvikā* (Grasses)—hundred (many) joints (*parva*) in its stem.

(*iii*) *Twaksāra* (Bamboo)—with hard (woody) skin.

(*iv*) *Drumotpala* (Pterospermum acerifolium)—lotus-like flowers on wood.

(*v*) *Apuṣpaphalada* (Jack-fruit)—fruit without (apparent) flowers.

E. **Local association:**

(*i*) *Saubîra* (Zizyphus jujube)— indigenous of Saubir (Sourāshtra).

(*ii*) *Chāmpeyā*—(Michelia sp.)—indigenous of Champā—Bhagalpur.

(*iii*) *Māgadhî* (Jasmine or Piper longum)—indigenous of Magadha—North Behar.

(*iv*) *Odrapuṣpa* (China rose)—indigenous of Odra—Orissa or China ?

(*v*) *Vaidehî* (Pepper)—indigenous of Videha—Mithilā—North Behar.

(*vi*) *Drāviḍaka* (Pīta śaṭhi)—indigenous of Draviḍ—the Deccan.

F. **Environmental association:**

(*i*) *Nadîsarjja* (Arjun—Terminalia arjuna)—grows on the banks of rivers.

(*ii*) *Jalaja* (*Hijal*—Barringtonia acutangula)—grows in water.

(*iii*) *Vānaprastha* (Bassia latifolia)—grows in woodlands.

(*iv*) *Paṅkerūha* (Lotus)—grows in mud.

(*v*) *Maruvaka* (Ocimum sp.)—grows in deserts.

(*vi*) *Hemavati* (Myrobalan)—grows on cold mountain.

(*vii*) *Kutaja* (Holarrhena antidysenterica)—grows on mountain peaks.

G. **Other characteristics:**

(*i*) *Vakula* (Mimusops)—often cited by poets.

(*ii*) *Śitabhīru* (Jasmine)—dies in (afraid of) winter.

(*iii*) *Māghya* (Kunda)—flowers in *Māgha* (February).

(*iv*) *Śāradī* (Jussieua repens or white lotus)—flowers during Autumn (*Śarat*).

(*v*) *Tiṣhyaphala* (Phyllanthus) — fruits in *Pōus* (December-January).

(*vi*) *Bhutābāsa* (Bayeḍa)—ghosts haunt these plants.

It may be noticed that the Hindu nomenclature of plants went further in this direction, being not satisfied with giving them denominations after particular features. It gave most of the plants double names—one based on a salient external feature (परिचयज्ञापिका संज्ञा), and the other on some prominent medicinal or other properties (गुणप्रकाशिका संज्ञा). Thus:

1. The plant Sesbania grandiflora is known as *Vakrapushpa* (curved flowers), *i.e*, with papilionaceous flowers, and also *Vranārī*

(the foe of boil) on account of its preventive property against that malady.

2. Ricinus communis is known as *Chitravīja* (having painted seeds), *Triputiphala* (with trilobed fruits), and also *Vātārī* (the enemy of rheumatism).
3. Balanites Roxburghii is known as *Tīkshṇakaṇtaka* (having sharp thorns), *Tailaphala* (having oily seeds), and also *Śūlāri* (destroyer of pains).
4. Achyranthes aspera is known as *Kharamañjarī* (having long and rough *spikes*), and *Kiṇihī* (killer of itches, boils, etc.).
5. Linum usitatissimum is known as *Nīlapushpīkā* (blue-flowered), and *Pichchhilā* (having slippery, *i.e.* mucilaginous seeds).
6. Calotropis gigantia is known as *Kshīrakāṇdaka* (having stems with milk), *Tūlāphala* (having wooly fruits), and *Kharjjūghna* (ringworm-killer).
7. Cassia fistula is known as *Swarṇapushpa* (with golden flowers), *Dīrghaphala* (long fruits—*lomentum*), and *Kushṭhasūdana* (curer of leprosy).
8. Datura alba is known as *Kaṇtaphala* (having spiny fruits), *Ghaṇtāpushpa* (having bell-shaped flowers), and *Mahāmohī* (great intoxicator).
9. Indigofera tinctoria is known as *Nīlapushpī* (blue-flowered), and *Rañjanī* (dyer).

10. Butea frondosa is known as *Triparṇa* (trifoliate), and *Kshāra-śreshṭha* (chief of alkalies).

11. Acacia arabica is known as *Yugmakaṇta* (with two spines), *Mālāphala* (having beaded fruits) and *Kaphāntaka* (ender of cough).

2. Classification of Plants.—The Hindu classification of plants was based upon three distinct principles, namely :

A. Udbhida—Botanical,
B. Virechanādi—Medicinal,
C. Annapānādi—Dietic.

A. **Classification on Botanical Principles.**—A broad classification of plants, probably based on stature, into Trees, Shrubs, Herbs and Creepers is to be found as early as in the texts of the Rigveda.[1] Plants were further classified into those that bore fruits and flowers and those that did not.

Manu's classification[2] of plants is distinctly clear. According to him :

(1) Those that bear abundant flowers and fruits, and wither after fructification are called *Oshadhis*, *e.g.*, Rice and Wheat (annuals).

(2) Those that bear fruits without evident flowers are called *Vanaspatis.*

(3) Both those which produce flowers only and those which produce fruits only may be classed as *Vrikshas.*

(4) Bushy herbs of various types may be classed as *Guchchha*, *e.g.*, Jasminum (*Mallikā* and the like).

[1] Rigveda X, 97, 15.
[2] Manu-saṁhitā I, 46, 47, 48

(5) Succulent shrubs of various types are known as *Gulmas.*

(6) Grasses of different kinds are called *Triṇas.*

(7) Creepers with stems spreading on the ground (procumbent and decumbent) are called *Pratānas.*

(8) Lastly there are those which twine round or climb a tree or a support called *Vallīs.*

Charaka[1] *classifies* plants into four orders:

Vanaspatis, Vīrudhs, Vānaspatyas and *Oshadhis.*

(1) *Vanaspatis*—are trees that bear fruits without flowers.

(2) *Vānaspatyas*—are trees that bear first flowers and then fruits.

(3) *Oshadhis*—are those herbs that wither after fructification.

(4) *Vīrudhs*—are herbs with spreading stem, *e.g.*, creepers and gulmas. (लतागुल्मादि:).

Chakrapāṇi, as Dr. Seal points out, notes in his Commentary on Charaka—*Vīrudhs* comprise two classes. (1) *Latās*—creepers, and (2) *Gulmas*—herbs with succulent or cactaceous stems and shrubs. The *Oshadhis* are subdivided into (1) annuals or perennials, bearing fruit, and (2) plants that wither away after maturing and

[1] Sūtrasthāna I, 36, 37.

without fructification, *e.g.*, grasses like the *Dūrvā* (Cynodon dactylon).

Suśruta[1] lays down almost an identical classification of plants. Thus "the immobile *Oshadhis* (plants in general) in their turn admit of being grouped under four sub-heads, such as the *Vanaspatis*, the *Vrikshas*, the *Vírudhs* and the *Oshadhis* proper.

"Those trees which bear fruit without blossoming are called *Vanaspatis*; those that bear both fruits and flowers are called the *Vrikshas*. Shrubs and creepers that trail on the ground are called *Vírudhs*, whereas those plants which die with the ripening of their fruits are called *Oshadhis* proper."

The commentator *Dalvana*,[2] as summarised by Dr. Seal, gives us some details, *i.e.*, illustrations of each class. "The *Plaksha* (Ficus infectoria) and the *Udumbara* (Ficus glomerata) are given as instances of trees bearing fruits without flowers (*Vanaspatis*). It appears that plants with naked and incomplete flowers (achlamydeous flowers) were considered as flowerless, as also trees whose flowers, like those of the fig, are placed on the internal walls of a common receptacle (*hypanthodium*). Of the *Vrikshas*, flower and fruit-bearing trees, the mango tree, the *Jambu* tree (Eugenia jambolana), etc., are

[1] Sūtrasthāna, I, 23, also *cf.* Eng. Trans., Vol. I, p. 12.

[2] Seal, Positive Science, p. 170.

given as examples. The *Vîrudhs* are of two classes—(1) creepers with stems spreading on the ground (प्रतानवत्यः), and (2) herbs with succulent or (cactaceous) stems (गुल्मिन्यः or स्तम्बिन्यः वर्त्तुलतासन्ततिविशिष्टाः). *Oshadhis* are those that wither away after fructification, *e.g.*, wheat, barley, etc. (फलपाकनिष्ठा गोधूमादयः). Some divide *Oshadhis* into two classes :

(1) those that wither after bearing fruits, *e.g.*, paddy, linseed, pulses, etc., and

. (2) plants that wither after maturity, and bear neither flowers nor fruits, *e.g.*, the mushroom, etc."

The Vaiśeshika commentator *Praśastapāda*[1] gives us a nicer classification of plants under six heads. Thus plants are divided into *Triṇas*, *Oshadhis*, *Vrikshas*, *Latās*, *Avatānas* and *Vanaspatis*. (स्थावरा स्तृणौषधिवृक्षलतावतानवनस्पतयः इति). *Triṇas* are grasses. *Oshadhis* are herbs that wither after fructification. *Vrikshas* are trees bearing flowers and fruits. *Latās* are spreading and creeping herbs. *Avatānas* are arboraceous plants and shrubs. And *Vanaspatis* are trees bearing fruits without flowers.

Śrîdhara[2] in his *Nyāya Kaṇḍalî* gives us illustrations of each of the above classes :—Thus *Ulapa* (Imperata arundinacea) as an example of *Triṇa*, *wheat* as an example of *Oshadhî*, *Kovidāra*

The Vizianagram Sanskrit Series, Vol. IV, p. 28. Benares, 1895.
The Vizianagram Sanskrit Series, Vol. IV, p. 28. Benares, 1895,

(Bauhinia) as an example of *Vriksha*, *Latā* is too well known to need any illustration, *Ketakī* (Pandanus odoratissimus) and *Vījapuraka* (Citrus medica) as examples of *Avatānas* (Vitapas—arboraceous plants, Seal) and the *Udumbara* (Ficus glomerata) as an example of *Vanaspati*.

Udayanāchāryya in his *Kiraṇāvalī* [1] gives illustrations of these classes which are almost identical with the preceding. Thus these are the plants:

(1) *Vrikshas*—are plants that bear flowers and fruits and have trunks and branches. (स्कन्द-शाखिनः).

(2) *Triṇas*—are *Ulapas* and plants of that type.

(3) *Oshadhis*—are plants that wither after fructification, such as *Kalama* (a species of paddy).

(4) *Gulmas*—are plants like *Bhāṭhās* (भाठाः ?).

(5) *Latās*—are plants such as *Kushmāṇda* (a species of Cucurbita) and the like.

(6) *Avatānas*—are *Ketakīs* and plants of the type.

(7) *Vanaspatis*—are trees that bear fruits without flowers.

[1] Bibliotheca Indica, New Series, No. 1342 (1912), Fasc. III, p. 256.

The same authority in his selection of articles erroneously mentions palm as a further illustration of *Triṇas* (तृणग्रहणेनैव तालादयः), and sesamum and paddy of *Oshadhis* (ओषधिग्रहणेनैव तैलतण्डुलादयः).

The classification given in the *Bhāgavata-purāṇam*[1] is almost the same. It, too, classifies them under six heads (वनस्पत्योषधिलतात्वक्सारावीरुधो द्रुमाः)—

(1) *Vanaspatis*—those that bear fruits without flowers.

(2) *Oshadhis*—those that wither after fructification.

(3) *Latās*—those that climb on others.

(4) *Twaksāras*—those that have hard bark (त्वक्) like bamboos.

(5) *Virudhs* – bushy shrubs.

(6) *Drumas*—those that bear both flowers and fruits.

Amara's classification of plants is very interesting being full of details showing a further advance in knowledge, and we cannot here do better than fully utilise the masterly summary done by so great a writer as Dr. B. N. Seal:[2]

[1] 3rd Skanda, 10th Chap., 19th Verse, with Srīdhara Swami's Commentary.

[2] Seal, Positive Science of the Ancient Hindus, pp. 171-173

(1) The trees (the flowering *Vrikshas* and the flowerless *Vanaspatis*) are fruit-bearing and possess woody stems काष्ठदारु or trunks (प्रकाण्ड-प्रकाण्डः स्कन्धः स्यान्मूलात् शाखाविस्तरः).

(2) *Arboraceous plants and Shrubs* (क्षुप, ह्रस्वशाखाशिफः)bearing flowers as well as fruits.

(3) The *Latās* are next noticed, flowering plants with herbaceous stems, some of them creeping on the ground (प्रतानिनी), others succulent (गुल्मिनी), others twining or voluble (मूलाच्चाग्रंगता लता, वृक्षगामिनी लता) *Cf.* Suśruta—लताप्रतानवत्यः गुल्मिन्यश्च ।

(4) Next the *Oshadhis* (in the narrower sense), herbaceous plants bearing fruits with or without flowers and dying or withering away after fructification. Some instances of *Kanda-śāka* (tubers, rhizomes, corms) are noticed, *e.g.* *Palāṇḍu* (the onion, पलाण्डुस्तु सुकन्दकः), the *Laśuna* (garlic, महाकन्दः), etc. But the graminaceae enumerated in the *Vaiśyavarga* are the chief instances of the *Oshadhis*—plants that die after fructification. These are cultivated *Oshadhis* but their affinities with the next class, the grasses (*Triṇas*) are also noted (*e.g.* धान्यं व्रीहि स्तम्बकरी । स्तम्बो गुच्छस्तृणादोनाम् । तृणधान्यानि नीवाराः, etc.).

Next are enumerated—

(5) the *Triṇas*, grasses of which the characteristic is the formation of *gulmas* (culms of grasses with annular knots from which leaves

spring—स्तम्बो गुल्मे तृणादीनामकाण्डद्रुमगुच्छयोः). It is worthy of note that, in the enumeration of the grasses, the bamboo is considered as a sort of giant grass (तृणध्वजः). The reeds (नलादयः) are also placed among the grasses (नलादयस्तृणं गर्मुच्छराशाकप्रमुखमपि । प्रमुखशब्दात् नीवाराद्याः).

(6) Finally, the *Palmaceae* (including the cocoanut, date, areca, and other palms) are classed as Tree-grasses, probably because, like the grasses they are endogens characterised by spikes and parallel veins (तृणद्रुमः).

"I (Seal) may add that *Amara* places parasitical plants among the *Latās* (वन्दा, वृक्षादनी, वृक्षरुहा, etc.). They climb trees and feed upon them (Cascuta). These are to be distinguished from climbing plants, like the *Guḍuchi* (Tinospora cordifolia), which have separate roots of their own. They are also to be distinguished from the adventitious roots descending from the branches of trees, like the Ficus religiosa, which are usually termed *Abarohas* (अवरोहाः).

The Hindu Materia Medica mentions *Ākāśavallī*, literally sky-creeper, a name which seems to have been originally intended for some orchids; also *Plava* (*lit.* floating), weeds that float in stagnant ponds, and *Śaivāla*, mosses and lichens (?) (*e.g.*, दूर्व्वाकसेरुप्लवशैवालं, etc., *Chakrapāṇi-saṁgraha*, also *Bhāba Prakāśa*). These are not classified, but like the mushrooms must come under the *Pākanishṭha aushadhis*—

'Aushadhis that die after maturing, without bringing forth flowers or fruits,' *i.e.* cryptogams.

We have so far discussed the classification of plants according to their *stature* and some salient *vital features* which represents just the first step in the scientific classification. In the next step the individual plants are sought to be arranged into certain well-defined groups, *genera* or classes according to resemblances in their *essential characteristics*. The individual plants coming under such a group, genus or class, in their turn are differentiated by certain *specific* features, primarily, *the colours of their flowers.* Thus:

1. The genus *Kovidāra* (Bauhinia) includes the *Śwetapushpa Kovidāra* (flowers white), the *Pītapushpa Kovidāra* (flowers yellow—B. tomentosa) and the *Raktapushpa Kovidāra* (B. purpurea) which resemble in almost all their essential characteristics but differ in the colours of the flowers. The *Śwetapushpa Kovidāra* is again differentiated into *Śwetakovidāra nirgandha* (B. acuminata), and *Śwetakovidāra surabhikusuma* (B. variegata) according as the flowers are not scented or scented.

2. Similarly the genus *Balā* (Sida) includes 4 species (बला चतुष्टयम्)—*Balā* (Sida cordifolia), *Atibalā* (S. rhombifolia), *Mahābalā* (S. rhomboidea) and *Nāgabalā* (S. spinosa).

3. The genus *Jhinṭi* (Barleria) includes 4 species (झिण्टिचतुष्टयम्)—*Saireyaka* (flowers white—B. longiflora or B. cristata var. dichotoma), *Dāsee* (flowers blue—B. cristata, or B. strigosa), *Kurantaka* (flowers yellow—B. prionitis), *Kuravaka* (flowers purple—B. ciliata).

4. The genus *Sigru* (Moringa), includes 3 species (शिग्रुत्रयम्)—*Swetā-śigru* (flowers white—Moringa pterygosperma). *Rakta-* or *Madhu-śigru* (flowers red) and *Sovāñjana* (flowers blue).

5. The genus *Śarapunkhā* (Tephrosia) includes 3 species (शरपुङ्खात्रयम्)—*Rakta-śarapuṅkhā* (flowers red—T. purpurea), *Sita-sarapuṅkhā* (flowers white—T. villosa) and *Kaṇtapunkhā* (T. spinosa).

6. The genus *Śaṅkhapushpī* (Canscora) includes 3 species—*Śuklapushpī* (C. decussata), *Raktapushpī* (C. diffusa) and *Nīlapushpī* (?).

7. The genus *Bhringarāja* (Eclipta) includes 3 species (श्वेतपीतनीलपुष्पभेदात् त्रयो भृङ्गराजाः सन्ति) *Śweta* (flowers white—E alba), *Pīta* (flowers yellow (?)) and *Nīla* (flowers blue (?)).

8. The genus *Pātalā* (Stereospermum) includes *Tāmra-pushpa Pātalā* (S. suaveolens), *Pīta-pushpa Pātalā* (B. chelonoides) and *Sita Pātalā* (Schrebera swietenioides).

9. The genus *Chandana* includes *Śweta-chandana* (Santalum album—गन्धराजं, सर्पावासं, मलयजम्), *Rakta-chandana* (Pterocarpus

santalinus—**प्रवालफलम्, रक्तसारम्**), *Kuchandana* (Adenanthera pavonia—**रक्तकाष्ठम्, पट्टरञ्जनम्**), *Kālīyaka* (? **पीतकाष्ठम्, नारायणप्रियम्**), *Barbarika* (? **श्वेतम् निर्गन्धम्**) and *Harichandana* **(महागन्ध',** **लोहितम्** ?).

10. The genus *Kośātakī* (Luffa) includes *Kośātakī* (L. echinata), *Kshudraphalā* (L. bindaal), *Brihatphalā* (L. graveolens), *Rājakośātakī* (L. amara) and *Dhārākośātakī* (L. acutangula), etc., etc.

B. **Classification of Plants based on Medicinal Properties.**—*Charaka*[1] classifies plants primarily into two divisions—Purgatives (**विरेचन:**) and the Astringents (**कषाय:**). And the Purgatives are six hundred and the Astringents are five hundred in number. The number of pre-eminently astringent groups are fifty which might again be sub-grouped under *ten* heads or *Vargas*, thus :

1. **First Varga :**

(1) *Jīvanīya* (Prolonging life)—*e.g.*, *Jīvaka* (Celtis orientalis), *Mudgaparṇī* (Phaseolus radiatus), *Māshaparṇa* (Teramnus debilis), *Jīvantī* (Dendrobium sp.), rest not identified. 6.

(2) *Vriṁghaṇīya* (Nutritive and promoting corpulency)—*e.g.*, *Rājakshāraka* (Asclepias rosea), *Balā* (Sida cordifolia), *Bharadwājī* (Hibiscus vitifolius), etc. 8.

(3) *Lekhanīya* (Thinning the tissues or reducing corpulency)—*e.g.*, *Musta* (Cyperus rotandus), *Kushṭha* (Aplotaxis auriculata) *Haridrā* (Curcuma longa), *Dāruharidrā* (Berberis asiatica), etc. 9.

(4) *Bhedanīya* (Promoting excretion)—*e.g.*, *Arka* (Asclepias gigantia), *Chitrā* (Rubia

[1] Charaka Saṁhitā, Sūtrasthāna, IV, pp. 25-29 (Bengali Edition). *Cf.* also Eng. Trans., Fasc. II, Lesson IV, pp 27-47

mañjishṭhā), *Chitraka* (Plumbago zeylanica), *Swarṇakshīrinī* (Polanisia felina). 10.

(5) *Sandhāniya* (Promoting the union of fractured parts)—*e.g.*, *Liquorice*, *Madhuparṇī* (Tinospora cordifolia), *Lodhra* (Symplocos racemosa), *Priyangu* (Aglaia Roxburghiana), *Katphala* (Myrica sapida), etc 11.

(6) *Dīpaniya* (Promoting appetite and digestion)—*e.g.*, *Pippalī* (Piper longum), *Chavya* (Piper chava), *Śringavera* (dry ginger), *Maricha* (Piper nigrum), *Ajāmodā* (Apium involucrata), *Bhallātakī* (Semecarpus anacardium), etc. 12.

2. **Second Varga:**

(1) *Valya* (Increasing strength)—*Rishavī* (Mucana pruriens), *Atirasa* (Asparagus racemosus), *Payasya* (Convolvulus paniculatus), *Aśwagandhā* (Physalis flexuosa), *Sthirā* (Desmodium gangeticum), *Rohiṇī* (Picrorrhiza kurroa). 13.

(2) *Varṇya* (Improving the complexion)—*Chandana* (Pterocarpus santalinus), *Tuṅga* (Calophyllum inophyllum), *Mañjishṭhā* (Rubia cordifolia), *Śarivā* (Hemidesmus indicus), etc. 14.

(3) *Kanṭhya* (Improving voice and curing hoarseness)—*Ikshumūla* (Saccharum officinarum), *Drākshā* (Uvōē passāē), *Vidārī* (Convolvulus paniculatus), *Haṁsapadī* (Hydrocotyle asiatica), etc. 15.

(4) *Hridya* (Promoting cheerfulness or relish)—*Āmra* (mango), *Āmrātaka* (Spondius mangifera), *Nikucha* (Artocarpus lakucha), *Mātuluṅga* (Citrus medica), etc. 16.

3. Third Varga:

(1) *Kaphaghna* (Removing phlegm that causes a sensation of satiety)— *Viḍaṅga* (Embelica glandulifera), *Murvā* (Sauseviera zeylanica), *Guḍuchī* (Tinospora cordifolia), *Patōla*, etc. 17.

(2) *Arśaghna* (Curing piles)—*Kutaja* (Holarrhena antidysenterica), *Vilva* (Aegle marmelos), *Ativisha* (Aconitum heterophyllum), *Abhayā* (Terminalia chebula), etc. 18.

(3) *Kusṭhaghna* (Curing skin-diseases)—*Khadira* (Acacia catechu), *Saptaparṇa* (Echites scholaris), *Āragvadha* (Cassia fistula), *Karavīra* (Nerium odorum), etc. 19.

(4) *Kaṇḍughna* (Curing prurites)--*Chandana* (Red sandal), *Nalada* (Nardostachys jatamansi), *Naktamāla* (Galedupa indica), *Nimva* (Melia azadirachta), etc. 20.

(5) *Krimighna* (Anthelmentic or Vermifuge)—*Akhira* (Moringa pterygosperma), *Keruka* (Costus speciosus), *Nirgunṭhī* (Vitex nirgundo), *Kinihī* (Achyranthes aspera), etc. 21.

(6) *Vishaghna* (Neutralising poison)—*Suvahā* (Vanda Roxburghii), *Paliṇḍī* (Ichnocarpus frutescens), *Kataka* (Strychnos potatorum), *Śirīsha* (Mimosa sirisa), etc. 22.

4. Fourth Varga:

(1) *Stanyajanana* (Galactiphorous)—*Vīraṇa* (Andropogon muricatum), *Śāli* (paddy), *Shashṭika* (paddy), *Darbha* (Saccharum cylindricum), *Kuśa* (Poa cynosuroides), etc. 23.

(2) *Stanyaśodhana* (Improving the quality of milk)—*Pāṭhā* (Stephania hernandifolia), *Suradāru* (Cedrus deodara), *Musta* (Cyperus rotandus), *Kirātatikta* (Agathotes chirayata), etc. 24.

(3) *Śukrajanana* (Increasing the secretion of semen)—*Jīvaka* (Celtis orientalis), *Vriddharuha* (Asparagus racemosus), *Jaṭila* (Phyllanthus niruri), *Kulinga* (Rhus acuminata), etc. 25.

(4) *Śukraśodhana* (Purifying the semen)—*Kushṭha* (Saussurea auriculata), *Kadamba* (Nauclea cadamba), *Ikshu* (Sugarcane), *Kāndekshu* (Ruellia longifolia), *Vāsuka* (Sesbania grandiflora), etc. 26.

5. Fifth Varga:

(1) *Snehopaga* (Emollients)—*Mridvīkā* (Raisin), *Vidārī* (Convolvulus paniculata), *Jīvantī* (Coelogyne ovalis), *Śālaparṇī* (Hedysarum gangeticum), etc. 27.

(2) *Swedopaga* (Diaphoretics)—*Śobhañjana* (Moringa pterygosperma), *Ekāranda* (Ricinus communis), *Vrischira* (Boerhavia diffusa *var*, white), *Punarnavā* (red variety), etc 28.

(3) *Vamanopaga* (Emetic)—*Kovidāra* (Bauhinia variegata), *Karvudāra* (B. acuminata), *Nīpa*

(Nuclea), *Vidula* (Calamus fasciculatus), *Vimbī* (Coccinea indica), *Śaṇapushpī* (Crotalaria verrucosa), etc. 29.

(4) *Virechanopaga* (Purgative)—*Kāchmārya* (Gmelina arborea), *Parushaka* (Grewia asiatica), *Abhayā* (Terminalia chebula), *Pīlu* (Salvadora indica), etc. 30.

(5) *Āsthāpanopaga* (Enemata)—*Trivrit* (Convolvulus turpethum), *Pippalī* (Piper longum), *Mustard*, *Vacha* (Acorus calamus), *Madanaphala* (Randia dumetorum), etc. 31.

(6) *Anuvāsanopaga* (Oily enemata)—*Rasnā* (Vanda Roxburghii), *Śālapushpa* (Pucedanum sowa), *Aśwadaṁgshtrā* (Tribulus terrestris), *Agnimantha* (Premna spinosa), etc. 32.

(7) *Śirovirechanopaga* (Errhines)—*Jyotishmotī* (Cardospermum halicacabum), *Kshavaka* (Myriogyne lanuginosus), *Śveta* (Clitorea ternata) white and red variety, etc. 33.

6. Sixth Varga:

(1) *Chhardinigrahaṇa* (Relieving vomiting) —*Jambu* (Eugenia jambolana), *Āmra* (mango), *Mātulunga* (Citrus medica), *Amla-vadara* (a variety of Zizyphus), etc. 34.

(2) *Trishṇānigrahaṇa* (Relieving thirst)—*Nāgara* (Cyperus partenuis), *Dhānwa-yavāsaka* (Hedysarum alhagi), *Parppataka* (Oldenlandia biflora), *Patola* (Trichosanthes dioica), etc. 35.

(3) *Hiccā-nigrahaṇa* (Relieving hiccup)—

Śaṭhi (Circuma zerumbet), *Kaṇṭakārika* (Solanum jacquinii), *Vrihatī* (Solanum indicum), *Vriksharuha* (orchid), etc. 36.

7. Seventh Varga:

(1) *Purīsha-saṁgrahaṇīya* (Rendering the fæces consistent)—*Kātwaṅga* (Colosanthes indica), *Mocharasa* (Bombax malabaricum), *Samānaga* (Mimosa pudica), *Dhātakī pushpa* (Grislea tomentosa), etc. 37.

(2) *Purīsha-virajanīya* (Altering the colour of the fæces)—*Śallakī* (Boswellia serrata), *Śrīveshtaka* (Pinus longifolia), *Payasyā* (Batatas paniculatus), *Utpala* (Nymphaea stellata), etc. 38.

(3) *Mūtra-saṁgrahaṇīya* (Reducing secretion of the urine)—*Plaksha* (Ficus infectoria), *Kapitāna* (Spondias mangifera), *Aśwattha* (Ficus religiosa), *Bhallātaka* (Semecarpus anacardium), etc. 39.

(4) *Mūtra-virechanīya* (Promoting secretion of urine)—*Vrikshādanī* (Cascuta), *Aśwadaṁgshtrā* (Tribulus terrestris), *Vaśira* (Cleome viscosa), *Pāshāṇabheda* (Bryophyllum calycinum), etc. 40.

(5) *Mūtra-virajanīya* (Altering the colour of the urine)—*Padma* (Nelumbium speciosum), *Utpala* (Nymphaea stellata, blue), *Nalina* (Nymphaea, white), *Kumuda* (Nymphaea, red), *Saugandhīka* (Nymphaea, lotus), *Puṇḍarīka*

(Nelumbium sp.), *Śatapatra* (Nelumbium sp), etc. 41.

8. Eighth Varga:

(1) *Kāsahara* (Curing cough)—*Durālabhā* (Hedysarum alhagi), *Śringī* (Rhus acuminata), *Drākshā*, *Abhayā*, *Āmalakī*, *Pippalī*, *Kaṇṭakārika*, etc. 42.

(2) *Śwāsahara* (Curing difficult breathing or Asthma)—*Saṭhi* (Circuma zerumbet), *Cardamoms*, *Amlavetasa* (Rumex vesicarius). *Hingu* (Ferula assafœtida), *Aguru* (Aquilaria agallocha), *Surasā* (Oseimum sanctum), *Chandā* (Andropogon acicularis), etc. 43.

(3) *Śotha-hara* (Curing anasarca or dropsical swellings)—*Pātalā* (Bignonia suaveolens), *Prishniparṇī* (Doodia lagopodioides), *Gokshuraka* (Tribulus lanuginosus), etc. 44.

(4) *Jwarahara* (Febrifuge)—*Sarivā* (Asclepias pseudosarsa), *Pāṭhā* (Stephania hernandifolia), *Pīlu* (Salvadora indica), *Abhayā*, *Āmalaka*, *Vibhītaka*, etc. 45.

(5) *Śramahara* (Removing fatigue)—*Drākshā*, *Kharjūra* (Phoenix sylvestrix), *Piyāla* (Buchanania latifolia), *Vadara*, *Phalgu* (Ficus glomerata), *Ikshu*, *Yava*, *Shashṭika*, etc. 46.

9. Ninth Varga:

(1) *Dāhapraśamana* (Relieving heat of the body or burning of the skin)—*Lāja* (Paddy, fried),

Chandana (Santalum album), *Nīlotpala* (blue lotus), *Hrivera* (Pavonia odorata), etc. 47.

(2) *Śītapraśamana* (Relieving sensation of coldness)—*Tagara* (Bignonia chelonoides), *Dhānyaka* (Coriandrum sativum), *Śringavera* (Zingiber officinarum), *Bhūtika* (Ptychotis ajowan), etc. 48.

(3) *Udarddapraśamana* (Curing urticaria)—*Tinduka* (Diospyros melanoxylon), *Piyāla*, *Asana* (Terminalia tomentosa), *Arimedā* (Acacia farnesiana), etc. 49

(4) *Aṅgamarddapraśamana* (Relieving pain in the limbs)—*Vidārigandhā* (Desmodium), *Vrihatī Kaṇṭakārī*, *Kairanda* (Ricinus), *Chandana*, *Cardamoms* (large), etc. 50.

(5) *Śūlapraśamana* (Curing pain in the bowels)—*Maricha* (Piper nigrum), *Ajāmodā* (Apium involucratum), *Ajāgandhā* (Cnidium diffusum), *Ajājī* (Cuminum cyminum), etc. 51.

10. Tenth Varga:

(1) *Śonitasthāpana* (Styptics) — *Rudhira* (Saffron, Crocus sativus), *Mel*, *Liquorice*, *Mocha* (Plantain), etc. 52.

(2) *Vedanāsthāpana* (Anodynes)—*Sāla* (Shorea robusta), *Katphala* (Myrica sapida), *Tuṅga* (Calophyllum inophyllum), *Aśoka* (Saraca indica), etc. 53.

(3) *Saṁjñāsthāpana* (Restoring consciousness)—*Kaitaryya* (Melia sempervirens), *Vayasthā*

(Gratiola monnieria), *Golomi* (Corydalis govaniana), etc. 54.

(4) *Prajāsthāpana* (Curing sterility)—*Aindri* (Karivia umbellata), *Śatavīryya* (Cynodon dactylon), *Abhyāthā*? (Musa sapientum), *Vātyāpushpī* (Sida cordifolia), etc. 55.

(5) *Vayasthāpana* (Preventing the effects of age)—*Amrita* (Tinospora cordifolia), *Dhāttri* (Phyllanthus emblica), *Mandukaparnī* (Hydrocotyle asiatica), *Punarnavā* (Boerhavia diffusa), etc. 56.

Classification according to Suśruta[1] –

Suśruta classifies plants (drugs) under thirty-seven sections or *ganas*. They are as follows:

1. **The Vidārigandhādi Group.**—Plants of this group have the virtue of subduing the action of deranged *Vāyu* and *Pitta* (bile) and prove beneficial in *Sosha* (phthisis), *Gulma*, *Urddhaśwāsha* (asthma) and cough.

Plants are—*Vidārigandhā*, *Sahadevā*, *Śatāvari*, *Vrihatī*, *Jīvāka*, *Kantakārī*, etc.

2. **The Āragvadhādi Group.**—These have the effect of destroying deranged phlegm, the effects of poison and *Meha* (morbid discharges from the urethra), *Kustha* (skin disease), fever, vomitting and itching of the body, etc., etc.

[1] Sūtrasthāna, Chap. XXXVIII.—General classification of drugs according to their therapeutical properties, pp. 342-356, Eng. Translation.

Plants are—*Madana*, *Âragvadha*, *Kutaja*, *Pāṭha*, *Pāṭalā*, *Saptaparṇa*, *Nimva*, *Patôla*. *Guduchi*, etc.

3. **The Varuṇādi Group.**—These are efficacious in cases of cephalaogia, *gulma* and internal abscesses, etc.

Plants are—*Varuṇa*, *Pūtika*, *Agnimantha*, *Vāsuka*, *Vilva*, *Ajāśringī*, *Darbha*, etc.

4. **The Vīratarvādi Group.**—The plants have the property of curing all urinary troubles.

Plants are—*Vīrataru*, *Gundra*, *Nala*, *Kuśa*, *Kāśa*, *Ashmabhedaka*, etc.

5. **The Sālasārādi Group.**—These have the effect of destroying the germ of *Kushṭha*, proves beneficial in case of *Pāṇduroga* (Chlorosis or Jaundice).

Plants are—*Sālasāra*, *Ajākarṇa*, *Khadira*, *Kālaskandha*, *Bhūrjja*, *Meshaśringī*, *Tinisha*, *Chandana*, etc.

6. **The Rodhrādi Group.**—" The group is antidotal to the deranged *Kapham*, etc., astringent in its properties, removes vaginal and uterine disorder, etc.

Plants are—*Rodhra*, *Palāśa*, *Aśoka*, *Katphala*, *Kadamba*, *Śāla* and *Kadalī*.

7. **The Arkādi Group.**—Acts as a vermifuge, and a specific asceptic agent amongst other properties.

Plants are—*Arka*, *Karañja*, *Nāgadantī*, *Rasnā*, *Indrapushpī*, etc.

8. **The Surasādi Group.**—Acts as above, besides proving beneficial in "catarrh, non-relish for food, asthma and cough."

Plants are—*Surasā*, *Bhustriṇa*, *Sugandhaka*, *Viḍaṅga*, *Kākamāchi*, *Nirguṇḍī*, etc.

9. **The Mushkakādi Group.**—Has the effect of "removing the defects of semen," efficacious in *Meha*, piles, jaundice, chlorosis, gravels, and urinary calculi in the bladder, etc.

Plants are—*Mushkaka*, *Palāśa*, *Dhava*, *Chitraka*, *Madana*, *Śiṁśapā*, *Triphalā*.

10. **The Pippalyādi Group.**—Acts as a good appetiser, and is an absorbent of intestinal mucous and unassimilated lymph chyle.

Plants are—*Pippalī*, *Chavya*, *Maricha*, *Elā*, *Sarshapa*, *Hingu*, *Ativisha*, *Vacha*, etc.

11. **The Elādi Group.**—It is a cosmetic, and arrests the eruption of pimples, etc.

Plants are—*Elā*, *Tagara*, *Priyangu*, *Aguru*, *Ushira*, *Punnāga*, *Keśara*, etc.

12. **The Vachādi and Haridrādi Groups.**—Are purifiers of breast milk, and curative of mucous dysentery (*Āmātisāra*).

Plants are—*Vacha*, *Musta*, *Abhayā*, *Bhadradāru*, *Nāgakeśara*, *Haridrā*, *Dāruharidrā*, *Kutaja*, etc.

13. **The Śyāmādi Group.**—It cures abdominal glands and acts as an anti-toxic and is one of the most reliable purgatives in cases of obstinate constipation of bowels with suppression of urine, etc.

Plants are—*Śyāmā*, *Trivrit*, *Dantī*, *Rāja-vriksha*, *Suvarṇakshīri*, *Karañja*, *Gavākshī*, etc.

14. **The Vrihatyādi Group.**—Is a good digestant or assimilator of the deranged humours; proves efficacious in "nausea, water-brash, dysuria," etc.

Plants are—*Vrihatī*, *Kaṇṭakārika*, *Madhuka.*

15. **The Patolādi Group.**—Is febrifuge, etc., restores appetite, etc.

Plants are—*Patóla*, *Chandana*, *Murvā*, *Katurohiṇī*, etc.

16. **The Kākolyādi Group.**—Increases the quantity of milk in the breast. It is a restorative, and an elixir, and is endued with the therapeutic virtue of augmenting the virile potency of a man.

Plants are—*Kākolī*, *Kshīra-kākolī*, *Mudga-parṇī*, *Medā*, *Mahāmedā*, *Chhinnaruhā*, *Padmaka*, *Riddhi*, *Vriddhi*, etc.

17. **The Usakādi Group.**—Cures *gulma*, urinary calculii, etc.

Plants are—*Hiṅgu*, *Kāsisa* and *Tutthaka.*

18. **The Sarivādi Group.**—Allays thirst, cures haemoptysis, removes burning sensation (*dāha*) of the body.

Plants are—*Sarivā*, *Madhuka*, *Chandana*, *Kāshmāriphala*, *Ushira*, etc.

19. **The Añjanadi Group.**—Anti-toxic, allays internal *dāha*, and cures haemoptysis.

Plants are—*Añjanā*, *Nāgapushpa*, *Priyangu*, *Nīlotpala*, *Nalada*, *Nalina*, etc.

20. **The Parushakādi Group.**—Acts as a cordial, increases appetite, etc.

Plants are—*Parushaka*, *Drākshā*, *Katphala*, *Dāḍima*, *Rājādana*, *Katakaphala*, etc.

21. **The Priyangvādi Group.**—Consists of *Priyangu*, *Dhātakī*, *Mocharasa*, *Rasāñjana*, etc.

22. **The Amvashthādi Group.**—Favours the healing of ulcers, bring about the adhesion of fractured bones, and dysentery (*pākvātisāra*).

Plants are—*Amvashṭha*, *Rodhra*, *Nandi-vriksha*, *Katvanga*, etc.

23. **The Nyagrodhādi Group**.—Proves beneficial in cases of ulcers, disorders of uterus and vagina, favours the adhesion of fractured bones, cures haemoptysis, etc.

Plants are—*Nyagrodha*, *Udumbara*, *Aśvattha*, *Plaksha*, *Madhuka*, *Kapitāna*, *Āmra*, *Jambu*, *Kadamba*, *Vadarī*, *Tinduka*, *Bhallātaka*, etc.

24. **The Guduchyādi Group.**—Is a good appetiser, and acts as a general febrifuge, etc.

Plants are—*Guḍuchi*, *Nimva*, *Kustumvuru*, *Cha·dana* and *Padmaka*.

25. **The Utpalādi Group.**—Allays thirst and proves curative in cases of vomiting, *Hridroga* (Angina pectoris), in syncope, in haemoptysis, and in cases of poisoning too.

Plants are—*Utpala*, *Raktotpala*, *Saugandhika*, *Kuvalaya*, *Puṇḍarīka*.

26. **The Mustādi Group.**—Cures uterine and vaginal disorders, purifies mother's milk, acts as a good digestant.

Plants are—*Musta*, *Haridrā*, *Haritakī*, *Âmalakī*, *Vibhītaka*, *Haimavatī*, *Drāviḍī*, *Bhallātaka*, etc.

27. **The Triphalā Group.**—Is a good appetiser, improves the eyesight and proves beneficial in chronic intermittent fever (*vishamajvara*).

Plants are—*Haritakī*, *Âmalakī* and *Vibhītaka*.

28. **The Trikatu Group.**—Destroys fat and *Kapha*, *Meha*, cures abdominal glands, catarrh, dullness of the appetite and indigestion.

Plants are—*Pippalī*, *Maricha* and *Śringavera*.

29. **The Âmalakyādi Group.**—Acts as a general febrifuge; it is also an aphrodisiac, and acts as a general tonic or restorative and appetiser.

Plants are—*Âmalakī*, *Harītakī*, *Pippalī*, and *Chitraka*.

30. **The Trapvādi Group.**—(all metals).

31. **The Lākshādi Group.**—Acts as a vermifuge, aseptic agent in cases of bad, malignant or indolent ulcers.

Plants are—*Lākshā*, *Ârevatā*, *Kutaja*, *Aśvamāra*, *Nimva*, *Saptachchhada*, *Mālatī*.

32. **The Svalpa Pañchamūla Group.**—It is a tonic, and aphrodisiac. Roots of : *Trikaṇtaka*, *Vrihatī* (two species), *Prithakaparṇī* and *Vidārigandhā*.

33. **The Mahat Pañchamūla Group.**—It is appetising. Roots of : *Vilva*, *Agnimantha*, *Tuntukā*, *Pātalā* and *Kāsmāri*.

34. **The Daśamūla Group.**—It proves beneficial in cases of Asthma and difficult respiration. The preceding *Mūlas* combined.

35. **The Vallī Pañchamūla Group.**—Roots of five medicinal creepers : *Vidārī*, *Sarivā*, *Rajanī*, *Guḍuchī* and *Ajāśringī*.

36. **The Pañcha-kaṇtaka Group.**—Five medicinal thorny shrubs : *Karamardda*, *Trikaṇtaka*, *Sāirīyaka*, *Śatāvarī* and *Gridhranakhī*.

37. **The Pañcha-triṇa Group.**—Five medicinal herbs (of the *grass species*), known as, *Kuśa*, *Kāśa*, *Nala*, *Darbha*, *Kāṇdekshuka*.

C. Classification of Plants based on Dietic Value.—*Charaka* [1] classifies plants also on the basis of dietic value under the following *vargas* (groups):

(1) *Śūka-dhānya varga*, (2) *Śamī-dhānya varga*, (3) *Śāka varga*, (4) *Phala varga*, (5) *Harita varga*, (7) *Ikshu varga* and (6) *Āhārayogī varga* (oil).

1. **Śūka-dhānya varga**—(all bearded grains), *i.e.*, those paddies that are provided with husks (glumes). " This group is subdivided into the following classes according to their tastes, potency and assimilation."

(1) *Śāli.*—They are cooling in their potency; in taste and assimilation they are sweet, capable of exciting the wind, a little constipating, oily, nutritive, and increasing semen and urine. 8-10. The group includes—the *red Śāli*, the *Mahāśāli* (grown in Behar-Magadha), *Kalama* (grown in Kashmir), *Śakunāhrita* (grown in Śravanti), *Chūrṇaka*, *Dīrghaśūka*, *Gaura*, *Pāṇḍuka*, *Lāṅgula*, *Sugandhika*, etc., etc. *Vāpya* (is a species that grows in deep water), *Naishadhaka* (grows in the country of Nishādhas), etc.

[1] Sūtrasthāna, Lessons XXVII, pp. 329-334 and 344 (Fasc. XI), pp. 345-362, 371-374 (Fasc. XII), and pp. 380-381 (Fasc. XIII), English translation.

(2) *Shashṭika*—"It is cooling, oily, heavy, agreeable, destructive of all the three faults, and invigorates the body, and makes it hard." The group includes two species which are white and dark. 14.

(3) *Baraka, Uddālaka, Chīna, Śārada, Gandhala, Kuruvinda, Ujjwala* and *Darddura*—are like (2). 15.

(4) *Vrīhi*—This variety is sweet, sour in assimilation, provocative of the bile and heavy. 16.

(5) *Pātala* (*Âśu-dhānya* gathered in the month of Aświn)—increases fæces, and urine, enhances the heat of the body and provokes all the three faults. 17.

(6) *Shyāmaka* (Panicum frumentaceum)—is astringent, sweet and light. 18.

(7) *Nīvāra, Toyaparṇī, Gavedhuka*, etc., etc., all resemble *Shyāmaka* in their virtues (many of them are not paddy proper). 19-20.

(8) *Yava* (Hordeum hexastichon) or barley—is dry, cooling, heavy, agreeable, etc. 21.

(9) *Veṇuyava*—a variety of the above. 22.

(10) *Godhūma* (wheat: Triticum vulgare)—unites fractures, cooling, prolongs life, promotes nutrition, enhances the semen, etc. 23.

(11) *Nāndīmukhī* and *Madhulī*—Varieties of wheat. 24.

Thus *Dhānya* includes grains of almost every species.

It will be noticed that all the above come under the modern family Graminaceae.

2. **Śamī-dhānya Varga.**—It includes—

(1) *Mudga* (Phaseolus mungo)—astringent, sweet in taste, etc. It is the foremost of all things whose soup or boiled juice is taken. 25.

(2) *Māsha* (Ph. radiatus)—increases the semen, etc. (26). Varieties of *Māsha* are—*Rāja-māsha* (Dolichos sinensis), *Kulattha* (Dolichos biflorus). • 27 & 28.

(3) *Makushtaka* (Phaseolus sublobatus)—is beneficial in haemorrhages, fevers, etc. 29.

(4) *Chanaka* (Cicer arietinum).

(5) *Masūra* (Cicer lens).

(6) *Khaṇḍika* (Pisum sativum) and other kinds of pulses and peas are light, cooling, etc. They are beneficial in affections of bilious phlegm. 30-31.

(7) The different variety of beans—when oilified, are fit to be eaten by men endued with strength. 33.

(8) *Ādhaki* (Cajanus indicus).

(9) *Nishpava* (Vigna catjang).

(10) *Ātma-gupta* (Mucana pruriens).

(11) *Umā* (*Atasī*—Linum usitatissimum, Linn.).

(12) *Eḍagaja* (Cassia tora).

All the above 12 kinds belong to the family Leguminoseae (Pea family).

It is curious to note that *Tila* (Sesamum indicum, *Tiliaceāe*) and *Avalguja* (Vernonia anthelmintica, *Compositeae*) are included in this group.

3. **Śāka Varga** (Pot-herbs)—Group of Vegetables—parts used are leaves, stems and fruits (include also bulbous roots).—

(1) *Pāṭhā* (Stephania hernandifolia), *Sushā* (Cassia sophora), *Śaṭhi* (Circuma zerumbet), *Vāstuka* (Chenopodium album), *Sunishannaka* (Marsilea quadrifoliata)—these are astringents which dry the fluids of the body. 89.

(2) *Kākamāchī* (Solanum nigrum)—increases the vital seed, it also cures leprosy. 90.

(3) *Rājakshāraka* (Asclepias rosea)—is specially applauded in diseases of the *Grahaṇī* and Piles. 91.

(4) *Āmrul śāk*—(Oxalis corniculata)—provokes the digestive fire, destroys the effects of poison and dropsical swellings.

(5) *Kālaśāka* (Corchoras capsularis), *Maṇdukaparṇī* (Hydrocotyle asiatica), *Vetāgra* (Calamus rotang), *Karkkotaka* (Momordica mixta), *Patola* (Trichosanthes dioica), *Somarājī* (Vernonia sp.), *Vrishapushpa* (Justicia adhatoda), *Śārngashthā* (Abrus precatorus), *Keṇuka* (Costus speciosus), *Punarnavā* (Boerhavia diffusa), *Kalāya* (Pisum sativum), *Gojihvā* (Elephantopus scaber), *Vārttāku* (Solanum melongana), *Tilaparṇika* (Cleome pentaphyla), *Kulaka* (Momordica

charantia), *Nimva* (Melia azadirachta), *Parp-pataka* (Oldenlandia biflora)—all alleviate excitements of phlegm and bile. 95-96.

(6) All kinds of kitchen vegetables, such as mungo, cicer, phaseolus, etc., Chlerodendron siphonanthus, a variety of Chenopodium album, Phlomis zeylanica, Dioscorea globosa, Ocimum sanctum, flowers of Crotalaria juncea and Bombax malabaricum, Bauhinia acuminata, Linum usitatissimum, Vigna catjung, Bauhinia variegata, Achanthes triandra, Beta bengalensis, Amarantus oleraceus, Convolvulus repens, Hibiscus canabinus, Rumex visicarius, Cucurbita pepo, etc.......these are heavy and dry. They are sweet in taste, cooling in energy, and (after digestion) purge the intestines of their contents without producing watery motions. 97-103.

(7) The flowers of *Śana*, *Bauhinia*, *Bombax*, etc., are inspissant and are much applauded in cases of bilious haemorrhage in especial. 104.

(8) The leaves of Ficus bengalensis, F. glomerata, F. religiosa, F. infectoria, Nelumbium speciosum and others are astringent in taste, operate as *stambhanas*, are cooling, etc.

(9) Tinospora, plumbago, Pothos officinalis, Aegle marmelos, Asparagus racemosus, Sida cordifolia, Caelogyne ovalis are capable of alleviating both wind and bile. 106-107.

(10) Gloriosa superba (*Laṅgulikā*) and Ricinus are purgatives.

(11) Sesamum, Calamus rotang—also purgative.

(12) *Śāka* of *Kausambha* (safflower)—alleviates phlegm and enhances bile. 108-109.

(13) Cucumis sativus, C. melo, Cucurbita lagenaria—purgative. 110-112.

(14) Nauclea cadamba—possesses inspissant qualities. 113.

(15) Nymphaea stellata is astringent and alleviates bilious haemorrhage.

(16) *Kharjjūra* and *Tāla-śasya*—are alleviative of bilious haemorrhage in Phthisis. 115.

(17) The stalk, flowers and fruits of both *Kumuda*, *Utpala*, Nymphaea lotus, Scirpus kaysoor, Trapa bispinosa, etc., are cooling, etc. 116.

(18) The bulbous roots of Convolvulus paniculatus (*Vidāri*) prolong life. 120.

4. **Phala Varga** (The Group about Fruits). The fourth order includes the following fruits :

Mridvika (Vitis vinifera)—it enhances the vital seed, its use is various and important. 124-125.

Kharjjūra (Phœnix Sylvestris)—beneficial in phthisis, etc. 126.

Phalgu (Ficus hispida)—promotes nutrition, etc.

Parushaka and *Madhuka* (Grewia asiatica and Bassia latifolia)—are applauded in cases of wind and bile. 127.

Āmrātaka (Spondias mangifera)—it operates as a tonic by increasing strength. 128.

Tāla (Borassus flabelliformis)—its kernel, and *Nārikela* (Cocos nucifera)—its fruit, operate as tonic for increasing the strength. 129.

Bhāvya (Dillenia speciosa)—corrects the taste of mouth. 130.

Vadara (Zizyphus jujuba), *Aruka* (not identified), *Karkandhu* (Zizyphus anoplia), *Lakucha* (Artocarpus lakoocha)—provoke bile and phlegm. 131.

Pārāvata (Anona reticulata—according to Wilson) is of two varieties. 133.

Kāśmārya (Gāmbhārī—Gmelina arborea) and *Tuda* (Morus indica). 134.

Tanka (a variety of wood apple of Kāshmir), *Kapittha* (Feronia elephantum)—destructive of poison, etc. 135-136.

Vilva (Aegle marmelos)— both ripe and unripe. 137.

Amra (Mangifera indica)—unripe and ripe. When ripe subdues the wind, and conduces to flesh, vital-seed, and strength. 138.

Tāmvava (Eugenia jambolana), *Śimvītika* (Pulses), *Gaṅgeruka* (Hedysarum lagopodioides), *Karira* (Capparis aphylla), *Vimbī* (Coccinea

indica), *Todana* (Grewia asiatica), *Dhanvana* (another variety of Grewia), Ripe *Panasa* (Artocarpus integrifolia), *Mochā* (Plantain), *Rājādanī* (Mimusops indica), *Lavalī* (Anona reticulata), *Nīpa* (Nauclea cadamba), *Śatāhvaka* (Aruthum sowa), *Pīlu* (Solvadora indica), *Triṇaśuṇya* (Pandanus odoratissimus), *Vikaṇtaka* (Flacourtia sapida), *Prāchīnāmalaka* (Flacourtia cataphracta), *Ingudī* (Ximenia aegyptiaca), *Tinduka* (Diospyros glutinosa), *Âmalaka* (Phyllanthus emblica), *Vibhītaka* (Terminalia belerica), *Dāḍima* (Punica granatum), *Âmlika* (Tamarindus indica), *Amlavetasa* (Rumex vesicarius), *Mātuluṅga* (Citrus medica), *Nāgaraṅga* (Citrus auranticum), *Bātāma* (Amygdalus communis), *Abhishuka* (Pestā), *Akshota* (Juglans regia), *Mukulaka* (Croton polyandrum), *Piyāla* (Buchanania latifolia), *Śleshmātaka* (Cordia myxa), *Añkola* (Alangium Lamarkii), *Śamī* (Acacia suma), *Karañja* (Pongamia glabra), *Vārtāka* (Solanum melongana), *Parkatī* (Ficus infectoria), *Akshiki* (Dalbergia oujeinensis), *Aśvattha* (F. religiosa), *Udumbara* (F. glomerata), *Plaksha* (Ficus infectoria), *Nyagrodha* (F. bengalensis), *Bhallātaka* (Semercarpus anacardium),—the individual properties of all the above fruits, their parts to be used, are described. 139-164.

It will be seen that the above is almost the exhaustive list of fruits that are used by the present inhabitants of India.

5. **Harita Varga** (The Group of Greens).—*Ārdraka* (Zingiber officinale), *Jamvīra* (Citrus sp.) promote the appetite. *Mūlaka* (Raphanus sativus) is destructive of all the faults. *Surasā* (Ocimum sanctum), *Yamānī* (Ptychotis ajowan), *Śigru* (Moringa pterygosperma), *Śāleya* (Cicer arietinum), *Vrīshtaka* (Sinapis ramosa), *Jalapippalī* (Commelyna salicifolia), *Gaṇdira* (Kidney bean), *Tumburu* (Zanthoxylum alatum), *Bhūstriṇa* (Andropogon schoenanthus), *Dhānyaka* (Coriandrum sativum), *Griñjanaka* (Turnips, also a variety of Garlic). *Palāṇdu* (Onion) and *Lasuna* (Garlic—Allium cepa and Allium sativum). 165-176.

Properties of each and every one of them are described.

6. **Āharayogi Varga** (The Oil Group).—The oil of *Sesame* is sweet, capable of penetrating even the minute nerves of the body and hot. It is the foremost of all things that are destructive of wind. If improved by admixture with other articles the oil of sesame is regarded as capable of alleviating all diseases. It is a tonic, it improves the skin, memory and intelligence and the digestive fire.

The oils of *Eraṇda* (Ricinus communis), *Mustard* seeds, the oil of *Piyāla* seeds (Buchanania latifolia), the oils of *Atasī* (Linum usitatissimum), *Kusumbha* (Carthamus tinctorius)—these oils are described with properties. 294.

15

Suśruta's[1] classification is more systematic and elaborate.

1. **Śāli Dhānya**—includes several species, such as *Lohitaka*, *Śāli*, *Kalama*, *Pāṇḍuka*, *Śītabhiruka*, etc. They are sweet in taste, cooling in potency, light of digestion and impart strength to those who use them. They are diuretic, spermatopoietic, refrigerent, eye-invigorating, cosmetic, tonic and pleasant. The properties of Śāli rice grown on burnt land, in a *jāṅgala* country, in *kaidāra* or marshy country, once transplanted (*ropya*) or those transplanted several times in succession (*atiropya*) are described. 4-7 ; 15-19.

2. **Shashtika Group**—includes several species of *Shashṭika*, *Kanguka*, *Peetaka*, *Churṇaka*, *Kuraka* and the *Kedāraka*, etc. They are sweet in taste and digestive, pacify the *Vāyu* and *Kapham*. They are constructive, tonic and spermatopoietic. The *Shashṭika* especially is light, mild, demulcent and imparts strength and firmness to the body. 8-11.

3. **Vrīhi Dhānyas**—include several species such as *Krishna Vrīhi*, *Śālamukha*, *Jatumukha*, *Nandimukha*, etc. They are sweet and astringent in taste, hot in their potencies. 12-14.

4. **Kudhānya Varga**.—The several varieties are : *Koradūshaka*, *Śyāmaka*, *Nīvāra*, *Uddālaka*,

[1] Sūtrasthāna, Chap. XLVI, Vol, I, pp. 469-526 (Englsh Translation which treats of food and drink—Annapāna Vidhimadhāya).

Veṇu Yava, etc. They generate heat, and have a sweet and astringent taste. They include four varieties (black, red, yellow and white) of *Priyaṅgus*. (Panicum italicum.) 21-26.

5. **Vaidala** (Several varieties of pulses) known as—*Mudga*, *Vana-mudga*, *Kalāya*, *Makushtha*, *Masura*, *Māṅgalya*, *Chanaka*, *Satīna*, *Triputaka*, *Harenu*, *Âdhakī*, *Māsha*, etc. They are generally cool and pungent of digestion, and have a sweet and astringent taste. Then he describes the properties of each of the above-mentioned pulses. *Âtmagupta* is included in this group. 27.

6. **Tila** and its varieties—(Sesamum and its varieties)—the black variety is the best in respect of efficacy, the white species occupies a middle position, while the remaining species are inferior. 39-40.

7. **Yava** (Barley) is cooling, sweet; *Godhūma* (wheat) is sweet, heavy, tonic, rejuvicient, spermatopoietic and improves the relish for food. 41-44.

8. **The Śimva** (Bean) with its four varieties—are heat-making. They are antitoxic, discutient, and reduce the *Kapham* and the power of sight. The four varieties are *white*, *black*, the *yellow*, and the *red*.

Kusumva, Linseed (*Atasī*) and white mustard are mentioned with their properties. 45, etc.

9. Phala Varga (The Fruit Group)—includes *Dāḍima*, *Âmalaka*, *Kapittha*, *Vadara*, *Kolā*, *Karkandhu*, *Sauvīra*, *Simvitikaphala*, *Mātulunga*, *Âmra*, *Âmrātaka*, *Karamardda*, *Piyāla*, *Lakucha*, *Bhārya*, *Pārāvata*, *Vetraphala*, *Prāchīnāmalaka*, *Tintiḍika*, *Nîpa*, *Koshāmra*, *Amlika*, *Nāraṅga*, *Jamvīra*, etc.

They are acid in taste, and heavy of digestion, heat-making in their potency, (expectorant) of *Kapham*, generate *Pittam* and subdue the *Vāyu*.

Two varieties of *Jamvīra* are mentioned—such as *Airāvata* and *Dantaśatha*.

The fruit (of such trees as the *Aśwattha*, the *Plaksha*, the *Udumbara*, etc., which pass by the general name) of *Kshīra-Vrikshas*, as well as those which are known as—*Jamvu*, *Rājādana*, *Todana*, *Tinduka*, *Vakula*, *Dhanvana*, *Aśmantaka*, *Aśvakarṇa*, *Phalgu*, *Parushaka*, *Gāṅgeruka*, *Pushkara*, *Varti*, *Vilva*, *Vimvī*, etc., are cooling and astringent in their effect.

The fruits, such as, *Tāla*, *Nārikela*, *Panasa*, and *Maucha*, etc., are sweet in taste and of digestion and subdue the *Vāyu* and *Pittam*.

The fruits, such as, *Drākshas*, *Kāshmaryas*, *Madhukas*, *Kharjjūras*, etc., have a sweet taste, are heavy of digestion and prove curative in cases of hæmoptysis.

The fruits such as *Vātāma*, *Akshoda*, *Abhishuka*, *Nichula*, *Pichu*, *Nikochaka*, *Urumāna*,

etc., are demulcent, heat-making in their potency, constructive, tonic, sweet in taste.

The fruits known as *Airāvata* and *Danta-śatha*, *Lavalī* (aromatic and refreshing to the whole system), *Vasiram*, *Śītapākyam*, *Bhallātaka*, *Aiṅgudam*, *Śleshmāntaka* are described with their properties.

Fruits such as *Karira*, *Akshaka*, *Pīlu*, *Triṇa-śūnya* have a sweet, bitter and pungent taste and heat-making in their potency. The *Arush-kara*, *Tauvaruka*; the *Karañja* *Kiṁśuka* and *Arishtaphalam* (*Nimva*), curative in cases of leprosy, *gulma* (internal tumour), ascites, piles and *prameha*.

The *Viḍaṅga*, the *Abhayā* (Chebulic myro-balans), the *Aksham*, *Pugu*; the fruits and vegetables, such as, the *Jātikosha*, *Jātiphalam*, *Katakaphalam*, *Kakkolakam*, *Lavaṅga* and the *Karpūra* are described with their extensive properties.

The *Latā-kasturī*, the *Piyāla*, *Vibhītakī*, *Kolā*, *Âmalaka*, *Vījapuraka*, *Shampāka* and *Koshāmra* are sweet in taste, digestion, appetising, demulcent, etc.

The *Vilvas*, both green and ripe, with their properties are described and recommended.

139-210.

10. Śāka Varga (The Group of Pot herbs). —The *fruit* of such creepers as *Pushpaphala*, *Alābu*, and *Kālindaka*. Of the *Alābus*, two

varieties are described. Tender *Kushmāṇdas* are recommended.

The fruits such as the *Trapusha*, *Ervāruka*, *Karkaru*, and *Śīrṇa-vrinta*—are described. A green and tender cucumber is distinguished from one which is of a pale yellow colour.

The *spices* and herbs include—the *Pippalī*, *Marīcha*, *Śriṅgavera*, *Ârdraka*, *Hiṇgu*, *Jīraka*, *Kustumvuru*, *Jamviraka*, *Sumukha*, *Surasā*, *Arjaka*, *Bhūstriṇa*, *Sugandhaka*, *Kāsamardda*, *Kālamāla*, *Kuṭheraka*, *Kshavaka*, *Kharapushpa*, *Śigru*, *Madhu śigru*, *Phaṇijhyakā*, *Sarshapa*, *Rājikā*, *Kulāhala*, *Veṇu*, *Gaṇdira*, *Tilapārṇika*. *Varshābhu*, *Chitraka*, *Mūlaka*, *Potikā*, *Laśuna*, *Palāṇdu* and *Kalāya*, etc. Their properties, individual and several, are described.

The *leaves* of plants and trees known as the *Chuchchu*, *Juthika*, *Taruṇī*, *Jīvantī*, *Vimvitika*, *Nandī*, *Bhallāṭaka*, *Chhāgalāntrī*, *Vrikshādanī*, *Phañji*, *Śālmalī*, *Śelu*, *Vanaspati-prasava*, *Śaṇa*, *Karvudāra*, *Kovidāra*, etc., the leaves of *Punarnavā*, *Varuṇa*, *Tarkari*, *Uruvaka*, *Vatsādanī*, *Vīlva*—are described.

The pot-herbs such as *Taṇduliyaka*, *Upodikā Aśvabala*, *Chilli*, *Pālankya*, *Vāstuka*, etc., are mentioned with properties.

The pot-herbs (leaves of edible plants) such as the *Maṇdukaparṇī*, *Saptalā*. *Sunishannaka*, *Suvarchalā*, *Brahma-suvarchalā*, *Pippalī*, *Guduchi*, *Gojihvā*, *Kākamāchī*, *Prapunnāda*, *Avalguja*,

Satina, *Vrihatī-phala*, *Kaṇṭakārikaphala*, *Patôla*, *Vārtāku*, *Kāravellaka*, *Katukikā*, *Kevuka*, *Uruvuka*, *Parpataka*, *Kirātatikta*, *Karkatoka*, *Arishta*, *Koshātakī*, *Vetra*, *Karira*, *Atarusāka*, *Arkapushpī*, etc., are light and palatable, and prove curative in haemoptysis, *Kushṭha*, *Meha*, Fever, Dyspnoea, Cough, and create a relish for food. 211-280.

11. **Pushpa Varga** (The Flower Group).—The flowers of such trees as the *Kovidāra*, *Śaṇa* and *Śālmalī*, prove curative in cases of haemoptysis. The flowers of *Vrisha* and *Agastya* alleviate phthisis (wasting cough). The flowers of *Madhu-śigru*, *Karira*, *Raktavriksha*, *Nimva*, *Mushkaka*, *Arka*, *Asana*, and *Kutaja* trees subdue *Pittam*, and prove curative in skin diseases (*Kushṭham*).

The *Padma*, *Kumuda*, its two varieties—*Kuvalaya* and the *Utpala*, the *Sindhuvāra*, the *Mallikā*, *Mālatī*, the *Vakulas*, the *Pātalā*, the *Nāga*, the *Kumkuma*, the *Champaka*, *Kiṁśuka*, *Kurantaka*—their properties are observed and recommended. 281-289.

12. **Udbhida Varga** (As sprouting up from beneath the surface of the ground—*Udbhida*).—Only one plant—Mushroom—is described under this head—its properties according to its place of origin, such as, stacks of straw (*Palālam*), on Bamboo (*Veṇujaṁ*), Sugarcane (*Ikshujam*), Cowdung (*Karīsham*) and

Bhūmijam, etc., are minutely observed and recommended. 290-293.

" पलाशेक्षुकरीषवेणुश्चितिजानि "—२८३ ।

13. Kanda Varga (The Bulb-group—edible bulbous plants or herbs).—The bulbs of plants and creepers, such as the *Vidārīkanda*, *Śatavārī*, *Viśa* (bulbs of the lotus plants), *Mriṇāla* (stalk of the lotus leaf), *Śringātaka*, *Kaśeruka*, *Piṇḍāluka*, *Madhvāluka*, *Hastyāluka*, *Kāsthāluka*, *Śankhāluka*, *Raktāluka*, *Indīvara*, *Utpala*, etc., alleviate haemoptysis, tend to increase the semen in large quantities and augment the quantity of milk in the breast of a human mother. 298-312.

The bulbs (*kanda*) known as *Sthūla-kanda*, *Śuraṇakanda* and *Mānaka* tend to produce a state of dryness in the organism. The *top-piths* of such trees as *Tāla*, *Nārikela*, *Kharjjūra*, etc., are also included in this group.

14. Taila Varga[1] (The Oil Group).—*Sesamum* oil, *Castor* oil, oils obtained from the seeds of *Nimva*, *Atasī*, *Mūlaka*, *Jīmūtaka*, *Vrikshaka*, *Kritavedhana*, *Arka*, *Kampillaka*, *Hastikarṇa*, *Prilhvika*, *Pīlu*, *Karañja*, *Iṅgudī*, *Śigru*, *Sarshapa*, *Suvarchalā*, *Viḍaṅga*.

The oils obtained from *Kirāta-tiktaka*, *Atimuktaka*, *Vibhītaka*, *Nārikela*, *Kolā*, *Akshoda*,

[1] Sūtrasthāna, Chap. XLV, Vol. I, pp. 444-449, English Translation.

Jīvantī, *Piyāla*, *Karvudāru*, *Sūrjavallī*, *Trapusa*, *Ervāruka*, *Karkaru* and *Kushmānda* seeds.

The oils of the *Madhuka*, *Kāshmārya*, *Palāśa* seeds, of the *Tuvaraka* and *Bhallātaka*.

The oils obtained from the piths (*sāra*) of such trees as *Sarala*, *Devadāru*, *Gāndira*, *Śiṁśapā* and *Aguru*; and various other oils with their sources are described and noted. Even oil from *mango* seeds are mentioned.
112-131.

15. The Sugarcane Group:[1]

पौण्ड्रको भीरुकश्चैव वंशकः शतपोरकः ।
कान्तारस्तापसेक्षुश्च काष्ठेक्षुः सूचिपत्रकः ॥
नैपालो दीर्घपत्रश्च नीलपोरोऽथ कोशकृत् ।
इत्येता जातयः, etc., etc., etc. ॥१५०॥

Amara[2] in his *Vanaushadhi Varga* and *Vaiśya Varga* enumerates many varieties of grains, pulses, spices, etc., as objects of food and articles of commerce. Thus in *Vaiśya Varga* we get the following grains and pulses :

माषादयः शमीधान्ये शूकधान्ये यवादयः ।
शालयः कलमाद्याश्च षष्टिकाद्याश्च पुंस्यमी ॥२४॥
तृणधान्यानि नीवाराः स्त्रीगवेधुर्गवेधुका ··· ॥२५॥

The following kitchen articles, condiments (वेसवारः, उपस्करः), are also mentioned : हरिद्रासर्षपं

[1] Sūtrasthāna, Chap. XLV., 150.

[2] With Raghunath Chakravartty's commentaries, Chandra Mohan Tarkaratna Edition 1886, Calcutta.

पिष्टमार्द्रकञ्च मरीचकम्। जीरकं शुष्कपत्रञ्चवेसवारः प्रकीर्त्तितः ॥ इति सूदशास्त्रम् ॥३५-४१ ॥

Tintiḍaka (Tamarind), *Bellaja* (Pepper), *Jīraka* (Cumin), **कृष्णे तु जीरके** (Nigella indica), *Ārdraka* (Ginger), *Chatra, Dhānyaka* (Coriander), *Hiṅgu* (Assafoetida), *Haridrā* (Turmeric).

But his enumeration of the Pot-herbs[1]—(*Śāka*—**शाकाख्यं पत्रपुष्पादिः**)—is more systematic and complete.

Raghunath Chakravartty in his commentary on the above Slokā, "classifies *Śāka* into ten groups, such as "**मूलपत्रकरीराग्र, फलकाण्डादिरूढ़कम्। त्वक्पुष्पं कवकञ्चैव, शाकं दशविधं स्मृतम् ॥**" that is, ten kinds of *Śākas* are—roots, tips, leaves, sprouting (*karīra*), fruits, rhizomes (bulbs), pith, bark, flowers and mushrooms. They are illustrated thus:

(1) *Mūlam* (roots)—*Mūlakādeḥ* (Radish and the like).

(2) *Patram* (leaves)—*Patolādeḥ* (Trichosanthes dioica and others).

(3) *Kariram* (*aṅkura*)—*Vaṁsādeḥ* (Sprouts of Bamboo and others).

(4) *Agraṁ* (tips, apices)—*Vetrādeḥ* (Calamus rotung and others).

(5) *Phalaṁ* (fruits)—*Kushmāndādeḥ* (Cucumber, Gourd, etc.).

[1] Vanaushadhi Varga, Sloka 135, p. 287.

(6) *Kāndaṁ* (stalk)—*Kadalyādeḥ* (Plantain rhizome, etc.).

(7) *Adhiruḍhakam* (pith)—at the head of Palmyra and Date palm.

(8) *Twak* (bark)—*Mātulunga* (Citrus medica), Red Bauhinia, etc.

(9) *Pushpam* (flowers)—Bauhinia, Sesbania, Gourd, etc.

(10) *Kabakam* (coming out of ground)—Mushroom.

Bhāvaprakāśa combines both the methods of classification of *Charaka* and *Suśruta* at one (*i.e.*, medicinal properties and dietic value). Thus :

1. Haritakyādi Varga (The Myrobalan Group) :

Under this group there are about 75 plants, only a few are noted below :

Haritakī (Terminalia chebula) with its 7 varieties, such as, *Vijayā*, *Rohiṇī*, *Putanā*, *Amrita*, *Abhayā*, *Jīvantī* and *Chetakī*, *Bayeḍā*, (Terminalia bellerica), *Âmalaki* (Phyllanthus emblica), *Ginger*, *Pepper*, *Cumin*, *Assafoetida*, *Fennel*, *Coriander*, etc., etc.

2. Karpūrādi Varga (The Camphor Group): This group includes about 49 species. Thus :—*Camphor*, *Musk*, *Mallow*, *Santālum* (with 2 varieties), *Sappan wood*, *Aguru*, *Cedrus deodara*, *Pinus*, *Nutmeg*, *Cloves*, *Cardamom* and such like fragrant spices and others. Spikenard, Saffron, etc.

3. **Guduchyadi Varga** (Tinospora Group):

Under this group are mentioned about 125 species. Thus: *Guḍuchī* (Tinospora cordifolia), *Tāmbul* (Piper bettle), *Vilva* (Aegle marmelos), *Gāmbhārī* (Gmelina arborea), *Sālaparṇī* (Desmodium gangeticum), *Vārttakī* (Solanum indicum), *Mudgaparṇī* (Phaseolus trilobus), *Pātalā* (Stereospurmum suaveolens), *Gaṇīkārikā* (Premna serratifolia), *Eraṇḍa* (Ricinus communis), *Karavīra* (Nerium odoratum), Datura, *Vāsaka* (Justicia adhatoda), Bauhinia, Melia, Calamus, Gossypium, Sida with 4 varieties (बलाचतुष्टयम्), Andropogon, Asparagus, Vitis, Indigofera, Aloe, Boerhavia, Lycopodium (वटपत्री), Maidenhair fern (हंसपदी), Salvinia, Cleome, Lippia, etc.

4. **Pushpa Varga** (The Flower Group):

This group includes about 33 species—almost all the known flowers used by the Hindus—thus: ~~the~~ lotus (Nelumbium speciosum) with six varieties—*Śveta* (white), *Rakta* (red), *Nīla* (blue), *Puṇḍarik*, *Kokanada*; Hibiscus mutabilis, Nymphaea lotus, *Kalhār*, Pistia stratiotes, Cerratophyllum, Jasminum with many species, *e.g.*, J. zambac, J. savibac, J. grandiflorum, J. auriculatum, etc., Michelia champaca, Mimusops, Sesbania, Nauclea, *Madhablatā*, Pandanus, Saraca, Pterospermum, China rose, Ocimum, Artemisia, etc.

5. **Vatādi Varga** (The Banyan Group):

This group includes about 42 species. Some of them are: the Banyan, Ficus religiosa, F. glomerata, F. oppositifolia, F. vagans, Acacia, Shorea, Terminalia, Mimosa (Sponge tree), Tecoma, Soap-nut, *Putrañjīva*, *Iṁgudī*, Cedrela toona, Betula bhojapatra, Butea, Bombax, Dalbergia, etc., etc.

6. **Āmrādi Phalavarga** (The Mango Group):

This group includes about 57 species. Thus: Mango, Spondias (Hog-plum), Artocarpus, Plantain, Cocoanut, Cucumber, Melon, Areca catechu, Palmyra, Palm, Aegle marmelos, Feronia elephantum, Citrus (orange), Ebony, Strychnos, Eugenia, Jujuba, Bassia latifolia, Morus indica, Punica granatum, Grape, Apple (*Sheu*), Date-palm, Walnut, Lemon, etc., etc.

7. **Dhānya Varga** (The Paddy Group):

This group includes about 34 species, divided into 6 sub-groups: *Śāli*, *Vrīhi*, *Shashṭika*, *Śāka*, *Simbī* and *Kshudra*.

(1) *Śāli*—Red variety, *Kalama*, *Pānduka* and 12 others grown all over India.

(2) *Vrīhi*—Black variety, *Pātala*, *Kukkutantaka*, etc.

(3) *Shashṭika*—*Shashṭika*, *Śatāpushpa*, *Promodaka*, etc.

(4) *Śūka* (with beards, awns)—Barley, *Yava* (wheat) with 3 varieties—*Mahāgodhūma*, *Madhulī* and *Dirghagodhūma*.

(5) *Śimbī* (pulses—grains in legumes or pods), such as, *Mudga*, *Māsha*, *Barbati* (Dolichos sinensis), Cicer lens, Cajanus, Gram, Pisum, Lathyrus, Dolichos biflorus, Sesamum, Linum, Mustard.

(6) *Kshudra*—Panicum italicum, Millet, Panicum frumentaceum, Paspalum scrobiculatum, *Deodhān*, *Nīvāra*, Andropogon saccharatus, etc.

8. **Śāka Varga** (The Pot-herb Group) :

This group is divided under six heads, and includes about 70 species. The six divisions are—*Leaves*, *Flowers*, *Fruits*, *Stem*, *Stalk*, *Moisture-born*.

(1) *Leaf vegetables*—This sub-group includes about 27 species. Some of them are :—Chenopodium, Amaranthus, Rumex, Corchorus, Ipomoea repens (*Kalambi*), Portuloca, Wood sorrel, Enhydra flactuans, Marsilea, Trichosanthes (*Patol*), Pisum sativum, Gram, Mustard, Cassia, etc.

(2) *Flower*—Sesbania, Plantain, Moringa, Bombax, Pumpkin, etc.

(3) *Fruit vegetables*—Pumpkin, Cucurbita lagenaria, Bottle gourd, Cucumis, Trichosanthes, Momordica, Solanum melongana, and about 15 others.

(4) *Stalk* (*Nāl*) vegetables—Mustard.

(5) *Kanda* (underground stalk)—about 15 species—Amorphophallus campanulatus, six

varieties of Potato, *e.g.*, *Kāsṭhālu*, *Śaṅkhālu*, *Hastyālu*, *Piṇḍālu*, *Madhvālu* (honeyed) and *Raktāluk* ; *Mūlaka* (Radish), Carrot, Plantain rhizome, Dioscorea, Scirpus keysoor, bulbs of Nymphoea lotus, Nelumbium, etc., etc.

(6) *Saṁsvedaja* (Moisture-born)—Mushroom, only the white variety is recommended as vegetable, the rest are poisonous.

9. Taila Varga (The Oil Group)—about 14 kinds of oils are described :

Tila, Mustard, Linseed, Castor, Almond, Cocoanut, etc.

10. Ikshu Varga (The Sugar-cane Group)—13 varieties are described. They are—*Pouṅḍraka*, *Vīruka*, *Vaṁsaka*, *Śataporaka*, *Kāntāra*, *Tāpasekshu*, *Kāndekshu*, *Sūchipatraka*, *Naipāla*, *Dīrghapatra*, *Nīlapora*, *Monogupta* and *Kośaka*.

SECTION VIII

PLANTS AND EVOLUTION

The ancients in India believed that plants had preceded animals, particularly man in the scale of creation, a fact confirmed by the evidences of modern Geology.

The first writer who gives a definite pronouncement upon the point is *Uddālaka*[1] who holds :

" The earth is the source (*rasa*) of all these elements (एषां भूतानाम्) ; water is the source of the earth ; again the essence of water is embodied in plants (*aushadhayo*—of herbs), and man represents the essence of plants and so forth."

Next comes *Varuṇa*[2] according to whom the elements are five—Ether, Air, Fire, Water and Earth. " Of these, in order of time Ether (*ākāsa*) springs from Brahman ; Air from Ether ; Fire from Air ; Water from Fire ; Earth from Water ; herbs from Earth: food from herbs ; seed from food ; and man from seed "—such is the evolution from the Supreme Brahman to Man.

[1] Chhāndogya Upanishad, Adhyāya I, Khaṇḍa I, 2.

[2] Taittirīya Upanishad, II, 1; Barua, IX, p. 145.

Yājñavalkya[1] maintains the above view in more details. Thus :

" Earth is the source of this creation—movable and immovable, for it supplies them with the constituents of their body ; and water again is the root cause of earth for earth is begotten of water ; the essence of water is embodied in plants such as grasses, creepers and the rest, flowers represent the essence of plants, and the essence of flowers are fruits, such as paddy, wheat and the rest."

An astonishingly modern idea of Evolution occurs in the following dialogue of Buddha :

" There come a time when the visible universe passes away, and consequently beings are reborn elsewhere in the nebular sphere. This is duly succeeded by a time when the world begins to develop anew. All is then water, and enveloped in darkness, a darkness that blinds. Those beings, falling from radiant worlds are reborn within the formed universe, made of consciousness, sustained by joy, floating in space, and shining in glory. The formed universe, the juicy earth (*rasa pathavi*) 'emerges from the waters like a scum of milk or ghee, odorous and sweet.' Having come in contact with it, feasting thereon, those beings become solidified, and lose thereby part of their luminance. Thus the Sun, the Moon and the Stars and Planets

[1] Bṛihadāraṇyaka Upanishad, 4.6.1.

appear once more, and the natural seasons come into existence. Meanwhile the cooling process goes on. As the juicy earth gradually becomes hardened, it loses its flavour and sweet taste, *but vegetation first of low, then higher grade evolves.* Man descends at length from his heavenly ancestors—from the vital Sun or the reflective Moon."

In this quotation [1] we notice a distinct mention of the evolution of plants in themselves from the low to the higher grade.

Let us sum up the chapter with an interesting anecdote from the *Rāmāyaṇa* [2] which very powerfully bears upon the precedence of plants to animals. The story is summarised below :

Once an owl and a vulture quarrelled over the possession of a nest in a certain tree each laying an equally emphatic claim to its ownership. Unable to settle the dispute themselves they preferred an appeal to Rāma. On being asked how long they had been there the vulture replied that he had been there since *man* began to inhabit the earth (मनुष्यैः परिवीयदा). The owl replied that he had been there since the earth became decorated with *plants* (पादपैरुपशोभिता). In consultation with his ministers Rāma decided in favour of the owl on the score of the prior appearance of plants on earth.

[1] Barua, History of the Pre-Buddhistic Indian Philosophy, XIV, pp. 217, 218

[2] Rāmāyaṇa, Uttarākāṇda, Canto 72, pp. 1393-1395, Bangabāsi Edition.

SECTION IX

MISCELLANEOUS APPLICATION OF THE SCIENCE

1. As a means of Economic Predictions.

A chapter[1] in the *Brihat Saṁhitā* is devoted towards the subject :

" फलकुसुम-सम्प्रवृद्धिं वनस्पतीनां विलोक्य विज्ञेयम् ।
सुलभत्वं द्रव्याणां निष्पत्तिश्चापि शस्यानाम् ॥ "

" One can infer the cheapness (सुलभत्वम्) of commodities by means of looking at the abundance of the growth and development of flowers and fruits in certain trees." 1.

One can infer the **cheapness** (सुलभत्वम्)—

" Of *Kalama Śāli* (paddy) from the abundant growth of flowers and fruits of *Sāla* (Shorea robusta), of red *Śāli* from red *Aśoka* (Saraca indica), of *Pāṇḍuka* (a variety of *Śāli* paddy) from *Dugdhikā* (Asclepias sp.) and of *Sukaruka* (paddy) from blue *Aśoka* (नीलाशोकेन)." 2.

" Of *Yavaka* (a variety of *Śāli*) from *Nyagrodha* (Ficus bengalensis), of *Shashṭika* from *Tinduka* (Diospyros melanoxylon), and of all *Cereals* (सर्व्वशस्यानाम्) from *Aśwattha* (Ficus religiosa)." 3.

[1] Here translated for the first time by the author. Chap. 29, Vol. I, pages 422-426.

"Of *Tilam* (Sesamum indicum) and *Māsha* (Phaseolus mungo *var.* Roxburghii) from *Jambu* (Eugenia jambolana); of *Priyaṅgu* (Panick) from *Śirīsha* (Mimosa sirisa), of *Wheat* from *Madhuka* (Bassia latifolia), and *Barley* from *Saptaparṇa* (Echites scholaris)." 4.

"Of *Gossypium* (कर्पासम्) from the abundance of *Atimuktaka* (Aganosma caryophyllata) and *Kunda* (Jasminum sp.); of *Sarshapa* (mustard) from *Asana* (Terminalia tomentosa); *Kulattha* (Dolichos biflorus) from *Vadarī* (Zizyphus jujuba); and *Mudga* (Phaseolus radiatus) from *Karañja* (Galedupa arborea or Robinia mistis)." 5.

"*Atasī* (linseed) from the flowers of *Vetasa* (Calamus rotung); *Kodrava* (Paspalum frumentaceum) from the flowers of *Palāśa* (Butea frondosa); *Śaṅkha* (Mother pearl), *Mukta* (pearl) and *Silver* from the *Tilaka* (Sesamum indicum) and *Śaṇa* (?) from *Iṅgudī* (Balanites Roxburghii)." 6.

"Elephants from *Hastīkarṇa* (Ricinus communis) and Horses from *Asvakarṇa* (a variety of Shorea robusta); Kine from *Pātalā* (Bignonia) and Goats and Lambs from *Plantain*." 7.

"Gold from the flowers of *Champaka* (Michelia champaka), cheapness (सम्पत्) of *Bidruma* (coral) from *Bandhujīva* (Pentapetes phœnicea or Ixora coccinea); *Bajram* (a kind of gem) from the overgrowth (वृद्ध) of *Kuruvaka*

(Barleria cristata, purple variety) and *Vaidūryyam* from *Nandikāvartta* (Tabernaemontana coronaria)." 8.

"One can infer the cheapness of *Mouktika* (pearls) from the *Sindhuvāra* (Vitex trifolia); (longevity and prosperity) of Artists (**कारुकाः**) from the *Kushumbha* (Safflower); and those of the *Rājā* (king) from the red lotus and of Minister from the blue lotus." 9.

"(Prosperity of) a *Sreshṭhi* (trader) is to be inferred from the *Suvarṇapushpa* (Cassia fistula), of the *Brāhmanas* from the lotus; of the *Purohita* (king's spiritual preceptor) from the Nymphaea alba (white lily); of the *Senāpati* (commander-in-chief) from the *Saugandhika* (a variety of the lotus), and increase of *gold* (wealth) from the *Arka* (Calotropis gigantea)." 10.

"(General) *well-being* is indicated by the *Mango*; *danger* (fear) by the *Bhallātaka* (Semecarpus anacardium); *recovery* (from illness) by the *Pīlu* (Salvadora indica or persica); *famine* by the overgrowth of *Khadira* (Acacia catechu), and *Samī* (Mimosa suma); and good (**शोभना**) *rain* by the *Arjuna* (Terminalia arjuna)." 11.

"Abundance of crop (**सुभिक्षम्**) by the flowers of *Pichumanda* (Melia azadirachta) and *Nāgakusuma* (Mesua ferrea), good *air* (climate) by *Kapittham* (Feronia elephantum); fear of *draught* (**अवृष्टिभयम्**) by *Nichula* (Eugenia acutangula), and

epidemic (fear of disease) by *Kutaja* (Holarrhena antidysenterica)." 12.

"*Ikshu* (sugarcane) by the flowers of *Dūrvā* (Agrostis linearis) and *Kuśa* (*Darva*—Poa cynosuroides); fear of *fire* by *Kovidāra* (Bauhinia acuminata); and the increase of *prostitutes* by the overgrowth of *Śyāma-latā* (Ichnocarpus frutescens)." 13.

Signs of coming rains (वृष्टिलक्षणम्):

"When *Vrikshas* (trees), *Gulmas* (shrubs and herbs) and *Latās* (creepers), become full of *snigdha* (graceful) and *nishchchhidra* (entire, untorn) leaves, (it is sure) that rains are coming; and when the plants (trees, etc.), bear leaves that are dry, ungraceful (रूक्षः), torn with many holes (छिद्रैः), it predicts scarcity of water, *i.e.*, of coming drought." 14.

तथा च पराशरः—

"अच्छिद्रपत्राः सुस्निग्धाः फलपुष्पसमन्विताः ।
निर्दिशन्ति शुभं वृक्षा विपरीतं विगर्हिताः ॥"

We have in Bengal a common saying[1] of a similar import:

"Abundance of mango forebodes an abundance of paddy crop; and Tamarind—flood."

[1] আমে ধান তেঁতুলে বান।

2. As a means of ascertaining the presence of water in a dreary region:

This chapter only gives a brief representation of the art through some select verses quoted from Brihat Saṁhitā where an elaborate chapter[1] containing some 115 slokas, is devoted to the topic. Thus:

" ....

Just as there are veins and arteries in the human system (carrying blood) up and down, so there are passages (शिराः) within the bowels of the earth at different depths carrying water." ... 1.

"If one finds a *Vetasa* plant (Calamus rotung) in a waterless tract, one is sure to find water by digging the ground at a distance of 3 cubits to the west of it half a *purusha* below the earth." (one *purusha* is equal to 120 *aṅgulas*—about 7 ft.). 6.

"If you find a *Jambu* (Blackberry) tree in such a land dig a hole 2 *purushas* deep, 3 cubits to the north of it, and you will find water running in a vein eastward." 8.

"If there be ant-hills close by to the east of the said *Jambu* tree you will surely find sweet water in a pit dug 2 *purushas* deep, 3 cubits to the south of it." 9.

[1] Translated for the first time by the author. Chap. 53, Vol. II, pp. 706-742.

"If a *Udumbara* (Ficus glomerata) tree is seen you are sure to find sweet water flowing in a vein, in a pit dug 2½ *purushas* deep, 3 cubits to the west of it." 11.

"If an ant-hill is found to the north of an *Arjuna* (Terminalia arjuna) tree, water will be found there 3½ *purushas* under the earth, at a distance of 3 cubits to the west of that tree." 12.

"If *Nirgundī* (Vitex trifolia) tree is found with an ant-hill, one will find tasteful water in a pit 2 *purushas* deep, 3 cubits towards the south." 14.

"If a *Vadarī* (*Zizyphus* jujuba) and a *Palāśa*-tree (Butea frondosa) are found together you will find good water, 3 *purushas* under the earth, 3 cubits towards the west of the former." 17.

"When a *Vilva* (Aegle marmelos) and an *Udumbara* (Ficus glomerata) tree are found growing together, you will get water 3½ *purushas* under the surface of the earth at a distance of 3 cubits from the trees." 18.

"Where to the north-east of a *Kovidāra* (Bauhinia acuminata) tree is found a white ant-hill with *Darva* (grass) over it, water will be found between them 5½ *purushas* under the ground." 27.

"If a frog is detected living beneath a tree one will surely get water 4½ *purushas* under the ground towards the north of that tree." 31.

"If an ant-hill inhabited by a serpent is found to the north of a *Madhuka* (Bassia latifolia) tree, you will get water at a distance of 5 cubits from the tree, 7½ *purushas* under the ground." 35.

"If you find a Palmyra tree or a Cocoanut tree with ant-hills, you will have a vein of good water flowing at a distance of 6 cubits to the west of either of the above trees 4 *purushas* under the ground." 40.

"There is water by the trees that are sappy, have long branches, or very dwarfish, or very spreading. And there will be no water near the trees that are sickly, have unhealthy leaves, and vapid." 49.

'"Water will be found 4½ *purushas* below the ground at a distance of three cubits to the north of the following trees surrounded by ant-hills: *Tilaka, Âmrātaka, Varuṇaka, Bhallātaka, Vilva, Tinduka, Aṅkola, Piṇdara, Śirīsa, Arjuna, Parushaka, Vañjula* and *Atibalā*." 50 & 51.

"If a thorny tree (*e.g. Khadira*) is found in the midst of thornless ones (like *Palāśa*), or a thornless tree is found in the midst of thorny ones, water will be found 3 *purushas* under the ground at a distance of 3 cubits to the west of such a tree." 53.

"If a *Kaṇtakārika* (Solanum sp.) plant is found without thorns and with white flowers,

water will surely be found under it at a depth of 3½ *purushas*." 57.

"The region where trees, shrubs and creepers are graceful possessing leaves that are untorn (entire) there are veins of water 3 *purushas* below the ground. Or where there are *Sthala-padma*, *Gokshura*, *Usira*, *Kula* with *Gundra*, *Kāśa*, *Kuśa*, *Nālik* or *Nāla* (all grasses); or where there are *Kharjjūra*, *Jambu*, *Arjuna*, *Vetasa*, or trees, shrubs or herbs with milky juice, or *Chhatrā*, *Hāstikarṇa*, *Nāgakeśara*, *Padma*, *Nīpa*, *Naktamāla* with *Sindhubāra* or *Vibhītaka*, *Madayantikā*, there will be found water 3 *purushas* below, even if it be on the mountain upon another mountain, *i.e.*, on a very high ground." 100, 101 & 102.

"Where there are *Śāka*, *Aśwakarṇa*, *Arjuna*, *Vilvasarjja*, *Śriparṇī*, *Arishta*, *Dhaba*, *Siṁśapā* with leaves torn (*i.e.*, unhealthy), and where the trees, shrubs and creepers look ungraceful, water is to be inferred to be off from that locality." 105.

The art of ascertaining the presence of water through its vegetable accessories reached a great perfection in India. It became a matter of common knowledge as it would be evident from the following anecdote summarised from a *Jātaka* story.[1]

[1] Story No. 2, Vaṇṇupatha Jātaka, Vol. I, Cambridge Ed., 1895.

Once upon a time the Bodhisattva born as a merchant, set out on a mercantile adventure. While passing through a wilderness he lost his wood and water. In his eager search for water he "ranged to and fro, while it was still early and cool until he came on a clump of *Kuśa* grass. "This grass," thought he, "can only have grown up here, thanks to the presence of water underneath." He caused a hole to be dug and "up rose the water in the hole till it was as high as a palm tree."

SECTION X

Concluding Remarks

Thus the result of our enquiry is that various observations of plant-life which are of scientific value, are contained in different Indian works and traditions. We cannot but appreciate the keenness of spirit shown. Unfortunately this spirit was not rigorously separated from fanciful superstitions and myth-making, with the result that the science of plant and plant-life could not make any further advance as a science. It degenerated into an art, and from art into an artifice. The soul fled and only the body remains.

APPENDIX A

HEREDITY

The principle of Heredity plays an important part in modern Biology. Darwin with his theory of *Pangenesis*, and Wiesmann with his theory of *Germ-plasm* and the neo-Darwinians and the neo-Wiesmannians with their improvements have not yet been able to come to any all-round satisfactory solution of the problem. And it is interesting to see what the ancient Biologists, coming at least two thousand years before Darwin and Wiesmann thought about this important problem. As plant life constitutes one of the principal themes of Biology we insert below Dr. Seal's Chapter[1] on Heredity in its entirety with full references of the text from which he derives his information :

"Transmission of specific characters—what parental characters are transmitted to offspring.—The question is raised in *Charaka*[2] (and earlier still in the *Brāhmanas*) how specific characters are transmitted—why the offspring is of the same species as the parental organism, say, the human or bovine species, the equine species, or the

[1] Positive Science of the Ancient Hindus, Section 9, pp. 233-239 (1915).

[2] Charaka, Śārīrasthāna, III, 22, p. 448 (Bengali Edition).

Aśwattha species (Ficus religiosa)—*Śankara, Brihadāranyaka-bhāshya.* Species (योनय:) may be compared to so many moulds, as it were, into which the ovum is cast, even as molten metals are cast in moulds. This is of course only an illustrative analogy; the cause has to be investigated.

Now *Charaka* and *Suśruta*[1] following *Dhanvantari* hold that the fœtus, or rather the fertilised ovum, develops by 'palingenesis' (instead of epigenesis); in other words, all the organs are potentially present therein at the same time and unfold in a certain order. As the sprouting bamboo seed contains in miniature the entire structure of the bamboo, as the mango-blossom contains the stone, pulp, the fibres, which appear separated and distinct in the ripe fruit, though from their excessive minuteness they are undistinguishable in the blossom, even such is the case with the fertilised ovum.

The inheritance of specific characters is explained in accordance with this view. *Charaka*[2] assumes that the sperm-cell of the male parent contains minute elements derived from each of its organs and tissues. (*Cf.* Darwin's "gemmule" and Spencer's "ids.")

[1] Suśruta, Śārīrasthāna, III, 18, p. 318, Yasodānandan Sen Edition of English Translation, Vol. II, p. 141.

[2] Charaka, Śārirasthāna, Chap. III, p. 449. Bengali Edition. For English Translation see Fasc. XXIV, Section 29, p. 733.

Śaṅkara[1] similarly states that the sperm-cell (or the seed in the case of a plant) represents in miniature every organ of the parent organism, and contains *in potentia* the whole organism that is developed out of it (शरीरधात्वात्मा शुक्रभूतः अङ्गादङ्गात् सम्भवति).

But if this is so, why are not congenital deformities of the parent, or constitutional diseases contracted in later life, invariably inherited? Congenital blindness, deafness, dumbness, stammering, lameness, or deformity of the spinal column or of the bony framework, or dwarfish stature, or constitutional diseases like madness, leprosy, or skin diseases in the parent, do not necessarily produce corresponding deformities or infirmities in the offspring. It cannot therefore be that the fertilised ovum represents in miniature every organ or tissue of the parental organism. The solution of this difficulty *Charaka*[2] ascribes to *Ātreya.* The fertilised ovum, it is true, is composed of elements which arise from the whole parental organism (समुदायात्मक, समुदायप्रभव), but it is not the

[1] Śaṅkara on Brihadāraṇyaka.

[2] Charaka, Śārīrasthāna, III, 22-26; English Translation, Fasc. 23, p. 730; Fasc. 24, Sec. 29, p. 733.

"Verily, in the seed from which the body springs, there are particular portions from which particular limbs grow. When a particular portion of the seed, therefore, is burnt up or consumed, the particular limb which would have grown out of it becomes deformed. No deformities again, occur if no portion of the seed becomes burnt up or consumed." Abināś Ch. Kaviratna's translation of the text,

developed organs of the parents, with their idiosyncracies or acquired characters, that determine or contribute the elements of the sperm-cell (or seed). The parental *Vīja* (seed, germ-plasm), contains the whole parental organism in miniature (or *in potentia*), but it is independent of the parents' developed organs, and is not necessarily affected by their idiosyncracies or deformities. In fact, the parental *Vīja* (seed, germ-plasm) is an organic whole independent of the developed parental body and its organs. In the parental *Vīja* an element representing a particular organ or tissue may happen (for this is accidental, दैव) to be defective or undeveloped, or otherwise abnormally characterised, and in this case the corresponding organ or tissue of the offspring will be similarly characterised. When constitutional diseases, acquired in later life, are found to be inherited, *Ātreya* would suppose that the *Vīja* of the parent has been affected, and this would explain the fact of the inheritance. In the case of leprosy, for example, it is transmitted to the offspring only when the germ-plasm (the *Vīja* or the fertilised ovum) is infected with the virus of the disease by reason of the leprosy of the parent.

N. B.—The seventh tissue (the *Śukradharā kalā*,[1] sperm-bearing or reproductive) contains

[1] Suśruta, Śārīrasthāna, IV, 20, 21, 22, 23, English Translation, Vol. II, p. 147.

the parental *Vīja*, which is a minute organism (समुदायात्मक) deriving its elements from the parental organs, but distinct from the latter, and independent of their peculiarities, and it is the combination and characters of these constituent elements of the parental *Vīja* in the reproductive tissue that determine the physiological characters and predisposition of the offspring. We may call this *Âtreya's germ-plasm* theory, for it is an advance on the conception of "gemmules" and "ids," but in *Âtreya's* version the "germ-plasm" is not only representative of the "somatic tissues," but also generates and is generated by the latter. This mutual interaction of the "germ-plasm" and the "somatic tissues" is a distinctive feature of *Âtreya's* hypothesis, the value of which will be differently estimated by different schools of biologists.

I may also add that the continued identity of the "germ-plasm" (बीज) from generation to generation, though it follows as a corollary from this doctrine of a distinct reproductive tissue, even when conceived to be affected by somatic processes, as *Âtreya* and *Charaka* conceive it

"Śukradharā kāla—extends throughout the entire body of all living creatures." 20.

"The physician should know that like fat (*Sarpi*) in the milk, or sugar in the expressed juice of sugar cane, the (seat of semen) is coextensive with the whole organism of a man (or animal) . . . . The semen under exhileration comes down from all parts of his body owing to the extreme excitement." 121-23.

to be, is nowhere expressly deduced. On the other hand, *Âtreya* and *Charaka* emphasise the influence of abundant or defective nutrition (see English translation 16, 17, pp. 774, 725), and of the constituents of the food, etc., on the characters of the *Vīja* in the reproductive tissue, especially as regards the sexual character, the stature, and the colour-pigment (वर्ण) of the offspring. But though the influence of nutrition on the *Vīja* is thus freely admitted in a general way, it is expressly stated that the peculiar characters or idiosyncracies of the elements that combine to form the *Vīja* must be regarded as a matter of chance (दैव), in other words, the truly congenital variations are accidental."

BOOK II

BOTANY AND SCIENCE OF MEDICINE

SECTION I

General Observations

The connection between the study of plant-life and the science of medicine has been intimate throughout the whole course of the genesis, development, and the culmination of the latter in India—from its genesis traced in the verses of the Rig Veda down to its culmination in the monumental treatises of *Charaka* and *Suśruta.* The application of plants as medicines as recorded in both these works are minute, exhaustive and extensive, and it is needless to reproduce the thing in detail. Here the study of the individual properties of plants, their application in diseases as means of cure, the collection of plants, the selections of plants, the preparation of drugs out of them, the selection of soils for plants to grow upon are excellently prescribed. No fewer than 26 forms of medicine derived from plants are mentioned. Instead of wasting space over what is common knowledge we turn to the more interesting task of tracing the historical development of the science of Medicine in Ancient India beginning from the earliest times down to its virtual stagnation.

SECTION II

Beginnings of Medical Science

The Vedic texts reveal to us the science in its rudimentary stage, while *Charaka* and *Suśruta* exhibit it in its full-fledged development, its practical consummation. We have no materials sufficient to show us in detail the processes through which the transition from the rudimentary stage of the science of which we get a picture in the *Atharva Veda* to the stage of its final development which we see in the *Charaka* and *Suśruta* took place, and we are left to vague conjectures and inferences. Only a hypothetical attempt based on warrantable evidences, can be made. Whatever may be the stages of its development, it is clear beyond all doubt that this useful science has not undergone any further progress since the time of *Charaka* and *Suśruta.* The later contribution on the subject, rich as it is in quantity, does not represent any improvement in quality, nor a single step of advance in the theoretical aspect of the science as science, and our attempt will necessarily be confined to a description of the direction taken by the science from its inception to its fullest development.

The first medical utterance of man is to be found in a text of the Rig Veda namely, in the *Aushadhi Sūkta* of the 10th *Maṇdala* which gives us a description in detail of the variety of the use to which plants used to be put. One hundred and seven applications are mentioned, but the number must not be taken literally but as a poetic statement of plurality. Here is the Sūkta.[1]

"Medicinal plants and herbs[2]—*Bhisaj*—the physician, son of *Atharva.*

1. I think of the hundred and seven applications of the brown-tinted plants, which are ancient, being generated for the gods before the three ages.

2. Mother (of mankind) a hundred are your applications, a thousandfold is your growth; to you who fulfil a hundred functions make this my people free from disease.

3. Rejoice, plants, bearing abundant flowers and fruits triumphing together (over disease) like (victorious) horses, sprouting forth, bearing (men safe) beyond disease.

4. "Plants"! thus I hail you, the divine mother (of mankind). I will give to thee, Oh physician, a horse, a cow, a garment—yea, even myself.

[1] All the translations are quoted from Wilson.

[2] Sukta VII (97), Vol. VI, p. 276, etc., Wilson

5. Your abode is in the *Aśwattha*, your dwelling is established in the *Palāśa*, you are assuredly the distributors of cattle, inasmuch as you bestow them on the physician [*Mahīdhara* says (XII, 79) the vessels in which the offerings are presented are made of the wood of these two].

6. Where, plants, you are congregated like princes (assembled) in battle, there the sage is designated a physician, these the destroyer of evil spirits, the extirpator of disease.

7. The *Aśvāvatī*, the *Somavatī*, the *Ūrjayantī* the *Udojasa* (are the four principal plants)—all these plants I praise for the purpose of overcoming this disease.

8. The virtues of the plants which are desirous of bestowing wealth issue from them, man, (towards) the body like cattle from the pen.

9. Verily *Ishkriti* is your mother, therefore are you (also) *Nishikritis*; you are flying streams; if a (man) is ill you cure him.

10. The universal all-pervading plants assail (diseases) as a thief (attacks) a cowshed; they drive out whatever infirmity of body there may be.

11. As soon as I take these plants in my hand making (the sick man) strong, the soul of the malady perishes before (their application) as (life is driven away from the presence) of the seizer of life.

12. From him, Oh plants, in whom you creep from limb to limb, from joint to joint, you drive away diseases like a mighty (prince) stationed in the midst of his host.

13. Fly forth, sickness, with the jay, with the blue jay, with the velocity of the wind, perish along with the iguana.

14. Let each of you, plants, go to the other, approach the one (to the vicinity) of the other; thus being all mutually joined together, attend to this my speech.

15. Whether bearing fruit or barren, whether flowering or flowerless, may they, the progeny of *Brihaspatī*, liberate us from sin.

16. May they liberate us from the sin produced by curse, from the sin cursed by *Varuṇa*, from the fetters of *Yama*, from all guilts caused by the gods.

17. The plants, falling from heaven, said, 'The man, whom living we pervade, will not perish.'

18. The plants which have the *Soma* for their king, and are numerous and all-seeing, of them thou (Oh! *Soma*-plant) art the best; be very bountiful to the affectionate heart.

19. Plants, which have the *Soma* for your king, and who are scattered over the earth, the offspring of *Brihaspatī*, give vigour to this (infirm body).

20. Let not the digger hurt you, nor (the

sick person) for whom I dig you up; may all my bipeds and quadrupeds be free from diseases.

21. Both the plants that hear (this prayer), and those which are removed far off, all coming together, give vigour to the (infirm body).

22. All the plants together with Soma their king, declare, 'We save him, O king, to whom the *Brāhman* administers us.'

23. Thou (*Soma*) art the best of the plants, to thee (all) trees are prostrate; may he be prostrate to us, who attacks us."

This hymn together with the one following it, namely, the hymn[1] addressed to a plant used against a rival wife, and the *Sukta* XVIII of *Maṇḍala* VII constitutes practically speaking the whole of the science or art, or both science and art, of Medicine as revealed in the *Rig Veda*. Here is the hymn to the plant against a rival wife:

"1. I dig up the most potent medicinal creeper by which (a wife) destroys a rival wife, by which she secures to herself her husband.

2. O (plant), with upturned leaves (the creeper referred to in the hymn is the *Pāṭhā*) auspicious, sent by the gods, powerful, remove my rival and make my husband my alone.

3. Excellent (plant), may I too be excellent amongst the excellent, and may she who is my rival, be vile amongst the viles.

[1] Sukta 145, Maṇḍala (10).

4. I will not even utter her name, no (woman) takes pleasure in that person, may we remove the other rival wife to a distance.

5. I am triumphing, thou art triumphant, we too being powerful will triumph over my rival.

6. I make the triumphant (herb) my pillow, I support thee with that more triumphant (pillow), let thy mind hasten to me as a cow to her calf, let it speed on its way like water."

And thus runs the verse of *Sūkta* 18, *Maṇḍala* VII:

" 2. May the brilliant *Agni* counteract that poison which is generated in manifold knots (of trees and the like).

3. The poison that is in *Sālmalī* tree (Bombax malabaricum), in rivers, or which is generated from plants, may the Universal gods remove from hence; let not the tortuous (snake) recognise me by the sound of my footsteps."

These three hymns taken together give us in a nutshell a world of ideas—a whole science in a few words. We get here the names of certain plants with *Soma*, the king of plants, at their head, and *Aśwavatī*, *Somavatī*, *Urjayantī* and *Udojasha*, and possibly also *Aśwattha* (Ficus religiosa) and *Palāśa* (Butea frondosa) as powerful agencies of cure against diseases. Innumerable applications of plants are referred to though not definitely named. We are told

that plants used to be applied as medicines, both individually and collectively, against diseases natural and supernatural, against bodily infirmities as well as against curses and the like. We also come to learn that plants could be used by themselves as well as in association with incantations and prayers. The genesis of the whole body of medicine is given as Divine, and the nature of the cure is clearly characterised as radical, permanent and comprehensive We are given in brief either the condensation, a scientifically nice epitome, or the germ of the Science of Medicine, of the art of cure, of demonology and classification of plants or Botany at once. Behind the wealth of poetry we get some solid facts of scientific importance. The whole thing has the air of a summary distinctly presupposing more elaborate statements, a knowledge of details. There is no vagueness, but freshness of the original revealed to us in an unmistakable language. Where are the details gone? They are either, to all intents and purposes, lost or they existed in popular memory and were handed down by tradition from generation to generation till at last they came to be synoptically recorded in some treatise; and the Vedic texts quoted may be the synopsis of a synopsis.

But we have a harvest of details bearing on the subject of medicinal plants, their utilities, their classifications, the diseases against which

they were applied, the association in which they were to be applied and the rest, in the text of the *Atharva Veda*.

These details seem to be an elaboration of what we get in a synoptical form in the three hymns of the *Rig Veda* just quoted. There are points of similarity between the two ; nay, there is essential identity. The latter seems to be an only elaborate edition, a popular commentary of the former. How are we to explain this ? Either the details of the *Atharva Veda* must be a development from and a lengthy explanation of the things we get in the *Rik*, or the *Rik* hymns give us a summary of the things so universally known.

SECTION III

MALADIES—THEIR CLASSIFICATIONS AND REMEDIES

In the Rig Vedic hymn already quoted the medicinal use of plants together with mention of some plants by name are given, classifications of plants are indicated, and the diseases, supernatural and natural, are referred to as being within the province of perfect and radical cure through the application of plants as drugs. For the sake of convenience and nicety, we now classify the medicinal plants of the *Atharva Veda* under the following heads:

1. Those that cure physical maladies brought about by purely physical agencies (*Kāyachikitsā*).
2. ,, ,, ,, supernatural maladies brought about by supernatural agencies (*Bhūtavidyā*).
3. ,, ,, help in the procreation and protection of children (*Kaumāravritya*).
4. ,, ,, are used for curing minor and serious wounds, etc. (*Śalyavidyā*).

5. Those that are used against the venom of snakes, and other insects (*Vishavidyā*).
6. ,, ,, ,, ,, for securing the prosperity and prolongation of life (*Rasāyana*).
7. ,, ,, ,, ,, for virility and erotic success (*Vājīkaraṇa*).
8. Miscellaneous.

1. *Physical Maladies.*

The medicinal plants that were used as drugs against diseases brought about by physical agencies are mentioned in the following hymns of the Atharva Veda :[1]

Bk. I. 2—against injury and diseases.
,, ,, 3—obstruction of urine.
,, ,, 23 and 24—against white leprosy.
Bk. II. 25—against abortion.
Bk. V. 4—against fever and other maladies.
Bk. XIX. 39—against disease *takman* (fever).

The physical maladies against which cure is provided are leprosy, fever, obstruction of urine, head-disease, evil of the eye, abortion and injury and diseases in general. Some of the several medicinal plants that are mentioned in the text have been identified with their modern representatives. These are *Reeds*, *Haridrā*, *Kushṭha*,

[1] Translations are quoted from Whitney's.

Chitraparṇī, etc. The genesis of the diseases in some cases are given and the method of the application of the drugs is nicely described. From the hymns containing cure against natural diseases, it is clear beyond all doubt, that the Science of medicine as revealed in the Atharva Vedic texts is far from being in a state of infancy. It presupposes a good deal of experiments and observation, and seems to be based on a wide generalisation.

"We know the reed's father, *Parjjanya* the much-nourishing; and we know well its mother, the earth of many aspects."—Plant identified is reed. (I. 2. 1.)

"Night-born art thou, O herb, O dark, black, dusky one; O colourer, do thou colour this leprous spot and what is pale." (I. 23. 1.)

"Of the bone-born leprous spot, and of the body-born that is in the skin, of that made by the spoiler—by incantation have I made the white mark disappear." (I. 23. 4.)

"The *Asura*-woman first made this remedy for leprous spot, this effacer of leprous spot; it has made the leprous spot disappear, has made this skin uniform." (I. 24. 2.)

Plant identified is *Haridrā*—Circuma longa.

"The blood-drinking wizard, and whoso wants to take away fatness, the embryo-eating *kaṇva* do thou make disappear, O spotted leaf and overpower." (II. 25. 3.)

Plants identified are :

1. *Māshaparṇī*—Glycine debilis.

2. *Lakshmaṇ*—Having upon its leaves red spots.

Putrajanī—*Bhābaprakāśa*, I. 208.

Putrakandā—*Rājanighaṇtu*, VII. 114.

Putradā—a bulbous plant.

3. It is a leguminous plant identified by U. C. Duta as Uraria lagopodioides. Dec.

" On an eagle-bearing mountain, born from the snowy one; they go to it with riches, having heard of it, for they know the effacer of fever." (V. 4. 2.)

" The *Aśwattha*, the seat of the gods in the third heaven from here ; there the gods won the *Kushṭha*, the sight of immortality." (V. 4. 3.)

" Born in the north from the *snowy* mountain, thou art conducted to people in the eastern quarter ; there they have shared out the highest names of the *Kushṭha*." (V. 4. 8.)

" Head-diseases, attack, evil of the eyes, of the body—all that may *Kushṭha* relieve, verily a divine virility." (V. 4. 10.)

Plant identified is *Kushṭha*—Costus speciosus or arabicus.

2. *Supernatural Maladies.*

Supernatural maladies, brought about by supernatural agencies, are mentioned in the following hymns of the Atharva Veda ;

Bk. II. 7—against curses and cursers.
Bk. IV. 17—against various evils.
„ 18—against witchcraft.
„ 20— to discover sorcerers.
„ 37—against various superhuman foes (against possession by evil spirits).
Bk. V. 14—against witchcraft
„ 15—against exorcism.
VI. 85—for relief from Yaksa.
VIII. 5. 2—against witchcraft, etc.
„ 7—to the plants for some one's restoration to health.

As the title indicates remedies of supernatural diseases were exclusively directed against supernatural agencies, such as demons, *Yakshas*, ghosts, curse of gods or the like. Plants used as drugs were sometimes applied by themselves, and sometimes in association with incantations, invocations, and magical formulæ. A pronounced characteristic of the Eastern system of medicine is that it provides for the cure against the diseases of the spirit, which the West has left to the region of incurability, where in the language of Macbeth's Physician—"the patient must administer to himself." Of all the supernatural diseases witchcraft seems to be the most

prevalent one, and a very large number of plants are prescribed as remedies against it. While giving remedies against this disease in detail, the hymns of the *Atharva Veda* coming under this head throw a lurid light upon the contemporary state of customs and beliefs—a state of civilisation characterised by ferocity, superstition, envy and malice. Besides witchcraft may be mentioned obsession by *Yaksha*, Demon, *Apsarā*, *Gandharva*, sorcery, curses, ghost, etc. All the plants prescribed are not, unfortunately, named; only a few and a very few have been identified with their modern representatives.

The application of the supernatural remedies in association with natural ones is a prominent feature of the ancient Medical Science, and the following quotations cursorily taken from the hymns will suffice to illustrate our remark :

"Let the curse go to the cursers; our [part] is along with him that is friendly; of the eye-conjurer, the unfriendly, we crush in the ribs." (II. 7. 5.)

Plant identified is *Durvā* (Panicum dactylon).

"The truly-conquering, the curse-repelling, the overcoming, the reverted one—all the herbs have I called together saying—may they save us from this." (IV. 17. 2.)

"Death by thirst, death by hunger, likewise

defeat at dice—through thee, O off-wiper, we wipe off all that. (IV. 17.7.)

Plants are—*Sahadevī* (Sida cordifolia and rhombifolia); and *Apāmārga* (Achyranthes aspera).

" O thou of thousand abodes, do thou make them lie crestless, neckless; take back the witchcraft to him that made it, like a sweetheart to a lover." (IV. 18. 4.)

"I, with this herb, have spoiled all witch crafts—what one they have made in the field, what in the kine, or what in thy men." (IV. 18. 5.).

" Whichever flies through the atmosphere, and whichever creeps across the sky; whichever thinks the earth a refuge that *Piśācha* do thou shew forth." (IV. 20. 9.)

Plant is—*Sadampushpā*—ever-flowering.

" By thee do we expel the Apsarases, the Gandharvas; O goat-horned one, drive the demon; make all disappear by thy smell." (IV. 37. 2.)

" Where are the *Aśwatthas*, the *Nyagrodhas*, great trees, with crests—thither go away, ye *Apsarases*; you have been recognised." (Popular belief is still prevalent that these plants are haunted by ghosts, etc.). (IV. 37. 4.)

" Hither hath come this mighty one of the herbs, of the plants; let the goat-horned *arāṭakī*, the sharp-horned, push out." (IV. 37.6.)

Plant is *Ajāśriṅgī*—Odina pinnata.

"The *avakā*-eating *Gandharvas*"—*Avakā* is Blyxa octandra (a grass-like marsh plant). (IV. 37. 8 & 9.).

"An eagle discovered thee; a hog dug thee with his snout; seek thou to injure, O herb, him that seeks to injure; smite down the witch-craft-maker." (V. 14. 1.)

"Be the witchcrafts for the witchcraft-maker, the curse for him that curses; like an easy chariot let the witchcraft roll back to the witchcraft-maker." (V. 14. 5.)

"The *Varaṇa*, this divine forest-tree, shall ward off the *Yaksha*, that has entered this man—that have the gods warded off." (VI. 85. 1.)

Plant is *Varaṇa*—Crataiva Roxburghii.

"Thou art the chief of herbs, as the ox of moving creatures, as the tiger of wild beasts; whom we sought, him have we found, a watcher near at hand." (VIII. 5. 11.)

"Those that are brown, and that are bright, the red and the spotted, the swarthy, the black herbs—all do we address." (VIII. 7. 1.)

"Food of fire, embryo of the waters, they tha grow up renewed, fixed, thousand-named—be they remedial (when) brought." (VIII. 7. 8.)

"Wrapped in *Avakā*, water-nurtured, let the herbs, sharp-horned, thrust away difficulty." (VIII. 7. 9)

(An amulet made of splinters of ten kinds of trees against all diseases.)

3. *Plants that Help in the Procreation and Protection of Children.*

Here we are to examine the art of procreation and preservation of children by means of plants. Side by side with procreation had to be considered the hindrances, natural and supernatural, and consequently the requisite remedies. Plants constitute a substantial section of the remedies used for the purpose.

The plants used for these purposes are mentioned in the following hymns:

Bk. II. 25—against abortion with a plant.

Bk. III. 23—for fecundity—"to procure the conception of male offspring."

Bk. VIII. 6—To guard a pregnant woman from demons.

The following quotations cursorily taken from the text will suffice to show both the nature of the remedy and the conception of the disease, both being comprehensive, radical and thorough:

"The blood-drinking wizard, and whose wants to take away fatness, the embryo-eating *kaṇva* do thou make disappear, O spotted-leaf, and overpower." (II. 25. 3.).

"The plants of which heaven has been the father, earth the mother, ocean the root—let those herbs of the gods favour thee, in order to acquisition of a son." (III. 23. 6.).

"The two spouse-finders which thy mother rubbed up for thee when born—for them let not the ill-named one be greedy, the *alinśa* nor the *vatsapa*." (VIII. 6. 1.)

"Whoever makes this woman one having a dead child, or a miscarriage, him, O herb, do thou make disappear, lustful for her, slippery." (VIII. 6. 9.)

(An amulet of white and yellow mustard plants.)

4. *Plants used for curing Wounds, etc.*

It is abundantly evident from the hymns of the *Atharva Veda* dealing with medicines for wounds, etc., that the surgical treatment, too, was considerably developed in Ancient India. The hymns are very few in number, but they are enough to show us that the first surgeons of India, for so we must call them, knew a good deal of anatomy, displayed a good deal of skill, in accurately examining the nature of the cases and in prescribing radical remedies against them. They also appear to be acquainted with a process of classification of plants. The following quotations typically selected will illustrate our remark.

To heal serious wounds with a herb :

"What of thee is torn, what of thee is inflamed, is crushed in thyself—may *Dhātar*

excellently put that together again, joint with joint" (boiled *Lākshā* water—perhaps it is a product of *Arundhatī* plant). (IV. 12. 2.)

"Let thy marrow come together with marrow, and thy joint together with joint; together let what of thy flesh has fallen apart, together let thy bone grow over." (IV. 12. 3.)

"Let marrow be put together with marrow; let skin grow with skin; let thy blood, bone grow; let flesh grow with flesh." (IV. 12. 4.)

"If by a staff, if by an arrow, or if by flame a sore is made, of that thou art relief; relieve thou this man." (V. 5. 4.)

"Out of the excellent *Plaksha* (Ficus infectoria) thou arisest, out of the *Aśwattha* (Ficus religiosa), the *Khadira* (Acacia catechu), the *Dhava* (Anogeissus latifolia), the excellent *Nyagrodha* (Ficus bengalensis), the *Parṇa* (Butea frondosa); do thou come to us, O *Arundhatī*" (a climber, Silācī by name). (V. 5. 5.)

Of these plants it may be a product.

"The berry, remedy for what is bruised, remedy for what is pierced—that did the gods prepare; that is sufficient for life." (VI. 109. 1.)

The plant is *Pippalī*—Piper longum.

5. *Plants used against the Venom of Snakes and other Insects.*

It is the proud distinction of the Indian system of medicine that it has provided for the

treatment against poison of snakes and other insects—a provision which is absent in some of the most advanced systems of medicine to-day. Even in this rudimentary state of the medicinal science with which we come across in the Atharva Veda we find that the poison of snakes has received attention in detail. The kind of snakes from which men were in constant apprehension of danger are distinctly mentioned.

The hymns dealing with medicine for venomous bite yields a harvest of historical results giving us the important truths that there was a distinct class of people treating patients suffering from snake-bites, that the *Kirātas*, perhaps a billy tribe, were discoverers of these remedies.

The very interesting thing in this connection is that the cure is not only all-comprehensive and radical but also vindictive, the agent of the mischief, the snake, being compelled by virtue of the remedy to take the poison of its own bite—thus the devil being hoisted with its own petard. This process might be regarded as an ancient anticipation of the modern process of auto-vaccination both being based on precisely the same principle of *vishasya vishamausha-dham*—poison is the antidote against poison. This wonderfully useful but academically unrecognised Science of Cure against snake-bite is successfully practised by illiterate but skilful

exorcists in obscure corners of this country. The germ of snake worship as represented by the modern *Vāstu* and *Manasā Pūjā* may be traced in one of the verses.

"With sight I smite thy sight; with poison I smite thy poison; die, O snake, do not live; let thy poison go back against thee." (V. 13. 4.)

"The eared-hedgehog said this, coming down from the mountain: whichsoever of these are produced by digging, of them the poison is most sapless." (V. 13. 9.).

"From the crosslined [snake], from the black snake, from the adder [what is] gathered—that poison of the heron-jointed one hath this plant made to disappear." (VII. 56. 1.)

The plant intended is "*Madhuka*" which is the name of various trees and herbs—Bassia latifolia.

"The little girl of the *Kirātas*, she the little one, digs a remedy, with golden shovels, upon the ridges of the mountains." (X. 4. 14.)

"Hither hath come the young physician, slayer of the spotted ones, unconquered; he verily is a grinder-up of both the constrictor and the stinger." (X. 4. 15.)

"Whichever of the snakes [are] fire-born, herb-born, whichever came hither [as] water-born lightnings; those of which the kinds are variously great—to those serpents would we pay worship with reverence." (X. 4. 23.)

"Remove thou it from every limb; make (it) avoid the heart; then, what keenness the poison has, let that go downward for thee." (X. 4. 25.).

6. *For securing Prosperity and Prolongation of Life with Plants.*

The Indian science of medicine deals with remedies both positive and negative, both preventive and curative. It takes into account man, not only in a state of disease but also in a state of health. It aims both at security and the prolongation of life. And in some of the hymns of the Atharva, we find mention of plants which either by themselves or in association with incantations lead to longevity. Most important of these plants are *Aparājitā*, *Parṇa*, *Palāśa*, *Aśwattha*, *Tāliśa* and *Śiṁśapā*. Prosperity is sought to be brought about by the defeat of foes too, which, curious as it might seem, could be brought about by the use of plants possessing supernatural properties. The plant *Aparājitā* (Clitoria ternata) is, as its etymology shows, born to grant invincibility, and the practice prevalent in Bengal of using it round one's upper arm on the great *Bijoyā* day is a revival of the past practice. The dead past is still living in the living present. Quotations made below bear on the above remarks:

"*Indra* put thee (*Aparājitā*) on his arm, in order to lay low the *Asuras*; smite the dispute

of (my) counter-disputant; make them sapless, O herb." (II. 27. 3.)

"*Indra* consumed the *pāṭhā*, in order to lay low the *Asuras*, etc." (II. 27. 4.).

The plant is *Pāṭhā* (Clypea hernandifolia).

"The *Parṇa* (Butea frondosa), Soma's formidable power, hath come, given by Indra, governed by Varuṇa; may I, shining greatly, wear it in order to length of life for a hundred autumns." (III. 5. 4.)

"As thou, O *Aśwattha* (Ficus religiosa) didst break out the *Khadira* (Acacia catechu) within the great sea, so do thou break out all those whom I hate, and who hate me." (III. 6. 3.)

"Thou art the highest of herbs (*Tāliśa*-plant); of thee the trees are subjects; let him be our subjects who assails us." (VI. 15. 1.)

The plant is *Tāliśa*—Flacourtia cataphracta.

"If with eye, with mind, and if with speech we have offended waking, if sleeping, let Soma purify those things for us with *Svadhā*."

(VI. 96. 3.)

"Me with a portion of *Śiṁśapā*, together with Indra as ally, I make myself portioned; let the niggards run away." (VI. 129. 1.)

The plant is Dalbergia sisu.

7. *Plants used for virility and Erotic Success:*

The vital importance of the problem of

virility was recognised by the Ancients in India and their medical science, even in its infancy, attacked it, and found out remedies both for increasing man's virility on the one hand and for destroying it on the other. In harmony with the spirit of the time the aid of medicinal plants used to be called for in impairing the virility of the opponents—a fact characteristically symptomatic of the then state of civilisation and culture. Very allied to the problem of virility is the problem of amatory success and we find a large number of plants mentioned in the Atharvanic hymns applied for the purpose, of course with supernatural aid in the shape of invocations and incantations. The following hymns deal with these topics :

Book I, 34.—A love spell with a sweet herb used in a ceremony for superiority in disputation.

Book III, 18.—Against a rival wife with a plant.

Book IV, 4.—For recovery of virility.

Book VI, 72.—For virile power.

„ „ 101— „ „ „

„ „ 138—To make a certain man impotent.

„ „ 139—To compel a woman's love.

Book VII, 38—To win and fix a man's love with a plant.

The quotations made below will illustrate the general spirit and tenor of these hymns:

"About thee with an encompassing sugar-cane have I gone, in order to absence of mutual hatred ; that thou mayest be one loving me, that thou mayest be one not going away from me." (I.34.5)

The plant is *Madhuka*—Bassia latifolia or *Yaṣthimadhu*—Glycyrrhiza glabra.

"I dig this herb, of plants the strongest, with which one drives off her rival; with which one wins completely her husband." (III. 18.1)

(A hymn exactly parallel to this is found in Rig Veda.)

The plant is *Pāṭhā* or *Vānaparṇī*—Clypea hernandifolia.

"Of the horse, of the mule, of the he-goat and of the ram, also of the bull what vigours there are—them do thou put in him, O self-controller." (IV. 4. 8)

The plant used is identified with *Kapitthaka* (Feronia elephantum.)

"As the black snake spreads himself at pleasure, making wondrous forms, by the Asura's magic, so let this *Arka* suddenly make thy member altogether correspondent, limb with limb." (VI. 72.1.)

The plant is identified with the *Arka* plant—Calotropis gigantea.

"Wherewith they invigorate one who is lean,

wherewith they incite one who is ill—with that, O Brahmaṇaspati, make thou his member taut like a bow." (VI. 101.2.)

(The amulet of *Arka* wood.)

"Thou art listened to, O herb, as the most best of plants; make thou now this man for me impotent, *opaśa*-wearing." (VI. 138.1.)

"A conciliator, a love-awakener, do thou, O brown, beauteous one; push together both yon woman and me; make our heart the same." (VI. 139.3.)

The plant is Andropogon aciculatus.

"If thou art either beyond people, or if beyond streams, may this herb, having as it were bound (thee), conduct thee in hither to me." (VII. 38.5).

The plant is *Śankhapushpikā*—or hemp.

SECTION IV

Miscellaneous Uses of Plants

1. *Utility of Plants in the Growth of Hair.*

Over and above the branches dealt with in previous sections of the paper, the verses of Atharva Veda contain a variety of uses to which plants used to be put. We place this under the head " Miscellaneous uses of plants." One of these topics is " the growth of hair." It is the outstanding merit of medical science in India that even in its infancy it took a due note of the vital relation of the body and the soul as also of the vital importance of considering its æsthetic aspects, and hence cosmatic consideration plays a part therein. Some hymns of the Atharva Veda mention plants used for contributing to the preservation, growth, development and nicety of hairs. The following extracts will give us an idea of the thing.

" O thou of great leaves, blessed one, rain-increased, righteous ! as a mother to her sons, be thou gracious to the hair, O *Śamī*." (VI. 30.3.)

(Prosopis spicigera and Mimosa suma).

"Fix thou the old ones, generate those unborn, and make longer those born." (VI. 136.2.)

"What hair of thine falls down, and what one is hewn off with its root, upon it I now pour with the all-healing plant." (VI. 136.3.)

"Fix thou the root, stretch the end, make the middle stretch out, O herb; let the black hairs grow out of thy head like reeds." (VI. 137.3.)

2. *Bk. X. 3. With an amulet of Varaṇa (Cratæva Roxburghii).*

This hymn of the Atharva Veda gives us the use of a plant employed for manifold purposes: the prevention of injury, atonement for hereditary sins, warding off foes, and the attainment of prosperity. The following quotations will amply bear us out:

"This *Varaṇa* is my rival-destroying, virile amulet; with it do thou take hold of thy foes, slaughter thy injurers." 1.

"From the niggard, from perdition, from sorcery, also from fear, from the more violent deadly weapon of death, the *Varaṇa* shall shield thee." 7.

"What sin my mother, what my father, and what my own brothers, what we ourselves have done, from that shall this divine forest-tree shield us." 8.

"I bear this *Varaṇa* being long-lived, one of a hundred autumns; may it assign to me both kingdom and authority, to me cattle and force." 12.

3. Bk. XIX. For various blessings with an amulet of Darbha (Poa cynosuroides).

The hymns 28, 29, 30, 32, 33, give us the variety of uses to which *Darbha* could be put for the purpose of the prolongation of life, for protection, for warding off enemies and for a variety of material blessings. The plant *Darbha* seems to be identical with modern *Kāśa* and *Kuśa*—which is still used for sacrificial purposes.

4. Bk. XIX. 31. For various blessings with an amulet of Udumbara (Ficus glomerata)

This hymn contains the multiplicity of blessings that the plant *Udumbara* (Ficus glomerata) yields—the blessings of progeny, material prosperity, protection against enemy and lordship over men and other animals. The quotations below will illustrate our remark:

"Let me be the over-ruler of cattle; let the lord of prosperity assign to me prosperity; let the amulet of *Udumbara* confirm to me possessions," 6.

"Unto me the amulet of *Udumbara*, with both progeny and riches: the amulet quickened by Indra hath come to me together with splendour." 7.

The plants *Jaṅgida* in hymns 34, 35; *Śatavāra* (Asparagus recemosus) in 36; and *Guggula* (Balsamodendron mukul) in 38,—are mentioned as remedies against diseases and for protection against witchcraft and various other blessings.

SECTION V

Development of Medical Science

Technically, the scientific treatise dealing with medical problems is the *Āyurveda* or the Science of life. From the statement in the *Charaka*, *Suśruta* and other medical treatises, it is clear beyond all possibility of doubt that there must have existed a monumental treatise of the name marking the intermediate period of transition between the Rig and Atharva Vedas on the one hand and the Charaka and Suśruta on the other. Without the hypothesis of the existence of such a work, a hypothesis which is very valid, the unbridgable gulf—a gulf of probably a thousand years or more according to Dr. P. C. Roy[1]—separating the rudimentary science of Medicine painfully gleaned out of the Vedic texts and the fully developed and scienti-

[1] "Where the humoral pathology is fully developed, the diagnosis and prognosis of diseases described at length, and elaborate mode of classification adopted."—Roy, History of Hindu Chemistry, Vol. I, p. viii (1902).

fically accurate works of Charaka and Suśruta cannot be explained. Some of the ancient authorities traced the origin of the lost work to the Atharva Veda and some to the Rig Veda, but the following statement occurring in the *Charaka*,[1] seems to be decisive on the point.

"If anybody enquires from which of the four Vedas—Rik, Sāma, Yaju and Atharva, *Âyurveda*, *i.e.*, the Veda of life emanates? What is life? Why the treatise is called the Science of life? Is it transient or permanent? What are the sub divisions of the Science of life, to whom it is open for study and why? A physician when thus interrogated, of all the four Vedas should mention the Atharva Veda emphatically as the Veda of life, *i.e.*, should point out the *Âyurveda* as a part of the Atharva Veda for this reason that the Atharva Veda has prescribed treatment by gift, expiation, sacrifice, atonement and fast, as well as incantations, and has prescribed treatment solely as conducive to the welfare of life, etc."

"It is called the *Âyurveda* or the Science of life because it enables us to understand what *Âyu* or life is. If asked how it explains life, the answer is this :—it is called *Âyurveda* because it brings home to us the nat re of *Âyu* by characterisation, by happiness, by misery, by good and evil, and by positive and negative proofs."

[1] Charaka I, Chap. XXX, 8 and 9.

The *Suśruta*[1] coming after Charaka precisely agrees with it in describing the same genesis of *Âyurveda.*

Those who hold to the Rig-Vedic[2] origin of the Science of life pointed out to the repeated mention of Rudra as the father of the Science of Medicine in the Rig Vedic texts (II. 7. 16). This view is echoed by later mythological literature, and the traditional association of Rudra with the healing science has been systematically maintained. Whatever that may be, the Atharvanic origin of the Science of life, the tracing of the genesis of the Charaka and Suśruta to the Atharva Veda seems to be warranted by facts. The divisions of the Science of Medicine as occurring in the Charaka and Suśruta[3] are as follows :—

(1) *Śalyatantra* (Major Surgery) ;

(2) *Sālakyatantra* (Minor „) ;

(3) *Kāyachikitsā* (Medicine) ;

(4) *Bhutavidyā* (Demonology) ;

(5) *Kaumāravidyā* or the Science of Pœdiatrics ;

(6) *Agadatantra* or Toxicology ;

[1] Suśruta I. I 3.

[2] "*Rigvedasyāurveda upaveda*"—Caranavyuha by Vyāsa. Âyurveda Patrikā—Âyurveder mūltatwa, 1319 B. S., Vol. I. *Cf.* also Devīpuraṇam, Chapter 107, p. 297, Bangabāsī edition.

[3] Charaka I. XXX. 15; Suśruta I 2. 3.

(7) *Rasāyana* or the Science that treats of prolonging life ; and

(8) *Vājīkaraṇatantra* or the Science of Aphrodisiacs, *i.e.*, treatment to stimulate the sexual power.

And these precisely correspond to the divisions of this science in its rudimentary stage as we have deduced in a previous section of this paper from the verses of the Atharva Veda.

The further story of the science of Medicine in India can be very briefly told. It is the story of monotony and stagnation—no development, no progress, no practical addition; rather, the spirit of enquiry, the desire of explanation, a hankering after the solution of each problem, the motive of searching analysis and scrutiny are all gone. In the Hindu Science of Medicine, Mythology with its vast array of gods and goddesses intrudes; and although the Science has been practised, and it is being practised still with wonderful efficacy, the progress has been arrested for good and all. The wonder of wonders is that the Indian Science of Medicine which was developed centuries before the modern Science of Medicine came into being, has stood so long the wear and tear of time, of revolutions and conquests and in all essentials is still as perfect as 'the most developed European system to-day' and, considered from the point of utility, it is peculiarly useful and

efficacious to the people of the land of its origin. The glory of it is that it can still cope with any other system of medicine and the misfortune and shame of it is that it has not received adequate attention and has not consequently undergone any improvement.

Book III

BOTANY AND SCIENCE OF AGRICULTURE

SECTION I

General Observations

The ancient Botanical Science and the ancient Science of Agriculture are so closely connected and interwoven with each other in Indian thought and practice, at any rate in the period of its infancy, that they cannot be well separated. In the present book we shall attempt a study of the historical development of the ancient Science of Agriculture with the object of incidentally illustrating the corresponding development of an aspect of the Botanical Science.

Agriculture requires the agency of three factors: the soil to be cultivated, the cultivator and the objects to be cultivated. All these three requisites are eternal and unchangeable in all ages and under all circumstances.

SECTION II

Beginnings of Agricultural Science

The earliest mention of Agriculture occurs in a hymn[1] of the Rigveda which definitely shows us that India was peculiarly fit for Agriculture which was then the staple industry of the country, the sole source of the supply of food and the universal occupation of the people. The northern India being very fortunate in supply of water owing to the existence of a net work of rivers, yielded crops with ease and in abundance; and the cream of the population, the highest section of the race, namely, the Brahmin *Rishis*, regarded agriculture as a holy and dignified occupation.

The following hymn from the Rigveda shows that agriculture constituted a theme of inspired speculation:

"With the master of the field, our friend, we triumph: may he bestow upon us cattle, horse, nourishment, for by such (gifts) he makes us happy." 1.

"Lord of the field, bestow upon us sweet, abundant (water), as the milch cow (yields her) milk, dropping like honey, bland as butter: may the lord of water make us happy." 2.

[1] Rigveda, IV. XII (LVII)—Wilson. Vol. III, pp. 224, 225 (1857).

"May the herbs (of the field) be sweet for us may the heavens, the waters, the firmament, be kind to us; may the lord of the field be gracious to us: let us, undeterred (by foes), have recourse to him." 3.

"May the oxen (draw happily), the men (labour) happily; the plough furrow happily; may the traces bind happily; wield the goad happily." 4.

"*Suna* and *Sira* be pleased by this our praise, and consequently sprinkle this (earth) with the water which you have created in heaven." 5.

"Auspicious *Sītā* (furrow) be present, we glorify thee: that thou mayest be propitious to us, that thou may yield us abundant fruit." 6.

"May Indra take hold of *Sītā*, may Pushan guide her; may she, well stored with water, yield it as milk, year after year." 7.

"May the ploughshares break up our land happily; may the ploughman go happily with the oxen; may *Parjanya* (water the earth), with sweet showers happily: grant, *Suna* and *Sira*, prosperity to us." 8.

This shows us very clearly that the Aryans by the time when the hymn was composed were settled in the fertile soil of North India and realised the vital importance of Agriculture as a staple and national industry for which they took a good deal of care and for which the Divine was invoked. They seem to acquire also a

sound knowledge of the science as it exists to-day, and a nice handling of the instruments of Agriculture, such as plough, etc.

From another hymn[1] quoted below it will appear that they had recourse to artificial water supply when necessary, and, as in modern Europe, used to employ horses as well as cattle in agricultural operations.

"Awake, friends, being all agreed ; many in number, abiding in one dwelling, kindle Agni. I invoke you, Dadhikara, Agni, and the divine Ushas, who are associated with Indra, for our protection." 1.

"Harness the ploughs, fit on the yokes, now that the womb of earth is ready sow the seed therein, and through our praise may there be abundant food; may (the grain) fall ripe towards the sickle." 3.

"The wise (priests) harness the ploughs, they lay the yokes apart, firmly devoted through the desire of happiness." 4.

"Set up the cattle-troughs, bind the straps to it; let us pour out (the water of) the well, which is full of water, fit to be poured out, and not easily exhausted." 5.

"I pour out (the water of) the well, whose cattle-troughs are prepared, well fitted with straps, fit to be poured out, full of water, inexhaustible." 6.

[1] Rigveda, X. CI. (Wilson, Vol. VI, pp. 289-291 (1888).

"Satisfy the horses, accomplish the good work (of ploughing), equip a car laden with good fortune, pour out (the water of) the well, having wooden cattle-troughs, having a stone rim, having a receptacle like armour, fit for the drinking of men." 7.

"Construct the cow-stall, for that is the drinking-place of your leaders (the gods), fabricate armour, manifold and ample; make cities of iron and impregnable; let not the ladle leak, make it strong." 8.

"The beast of burden pressed within the two wagon-poles, moves as if on the womb of sacrifice having two wives. Place the chariot in the wood, without digging store up the juice." 11.

The following quotation[1] goes to show that lands used to be distributed among cultivators by measurement, a fact which is full of meaning. "Measure the land with a rod."

This noble pursuit was so well conducted and the agricultural products so plenty that hospitality came to be regarded as a holy duty religiously enjoined—an ideal which is upheld in India even to-day. The following quotations[2] powerfully bear on the following points:

"The gods have not assigned hunger as (the cause of death), for deaths approach the man who has eaten; the riches of one who gives do

[1] Rigveda, Vol. I, p. 56 (Wilson).

[2] Rigveda, X, 117 (Wilson); Vol. VI, pp. 328, 329.

not diminish, he who gives not finds no consoler." 1.

"He who, possessed of food, hardens his heart against the feeble man craving the nourishment, against the sufferer coming to him (for help), and pursues (his own enjoyment even) before him, that man finds no consoler." 2.

"He is liberal who gives to the suppliant desiring food, wandering about distressed; to him there is an ample (recompense), and he contracts friendship with his adversaries." 3.

"He is not a friend who gives not food to a friend, to an associate, to a companion; let him turn away from him, that is not a (fitting) dwelling; let him seek another more liberal lord." 4.

"Let the very rich man satisfy his suitor, let him look forward to a more protracted route, for riches revolve from one man to another as the wheels of a chariot turn round." 5.

"The inhospitable man acquires food in vain. I speak the truth—it verily is his death. He cherishes not Aryaman, nor a friend; he who eats alone is nothing but a sinner." 6.

"The ploughshare furrowing (the field) provides food (for the ploughman)...(so) let the man who gives become a kinsman to the man who gives not." 7.

The art of Agriculture as it can be gleaned from the verses of the Atharva

Veda[1] is practically a reproduction of what we get in the Rik. Thus:

HYMN 17 : *For Successful Agriculture.*[2]

This hymn begins by asking the poets to "harness the ploughs" and "to extend severally the yokes," and "scatter the seed in prepared womb," and so forth—a fact showing us unmistakably that poets in their fine frenzy of a joyous vision, and wise men in their meditative quest after truth, at least occasionally made time to hold the plough and to cultivate the land as a means of earning the livelihood—food without which no poetry, however excellent, and no philosophy, however grand, is possible. The picture of the art of cultivation as we get in this hymn does not differ a bit materially from the same art practised by the peasants in India to-day. There is the same mode of ploughing the land, preparing the womb of the earth, cutting the corn with the same sickles when they are ripe only with this distinction that the profession was then sanctified with a hallow of divinity.

HYMN 24 : *For Abundance of Grain.*[3]

The hymn is addressed to the god of plenty so that he might favour his worshippers with an abundance of grain.

[1] All the hymns of the Atharva Veda referred to in this thesis are from Whitney (1905).

[2] Atharva Veda, Book III, p. 114.

[3] Atharva Veda, Book III, p. 129.

The 5th verse supplemented by the 7th gives us an idea of the village life based on communal principle. It does not seem to be improbable that the villagers used a plot of land in common, where they used to graze their cattle, and cultivate the land, and sow and reap the corn collectively. The five races of men referred to may be the five bodies of men—namely, the ploughmen, the sower, the reaper, the gatherer and the bringer and the distributor. All these were engaged in the common work of cultivation in the most comprehensive sense of the word. The theory of the division of labour seems to have been understood, realised and thoroughly practised by the Ancients. At the very early stage of society a race of invading immigrants, just settled in groups in an unreclaimed land, could not do better than fall upon the method of organisation on communal basis—one headman with his band of followers, supervising, controlling and distributing the produce of the common land amongst his followers much after the fashion of a father in a family.

Reading the verses between the lines we can get a clear idea of the village construction with the "village common" in the centre surrounded by habitations on all sides, whence people used to come when necessary to carry on the work.

"These five directions that there (village) are, the five races (ploughman, etc.) descended from

Manu—may they bring fatness (contribute to the production of abundant grain) together here, as streams drift when it has rained." 5.

HYMN 15.[1]

This hymn conveys a beautiful tribute to rain which is a vitally necessary agency in the luxurious development of herbs and plants. The connection between rain and the growth of corn is gratefully and poetically acknowledged. The condition of Agriculture in India is precisely the same now as it was in the days of the Atharva, and the following invocation of rain might well be put in the mouth of a devout peasant to-day:—"let the mighty liberal ones cause to behold together; let the juices of the waters attach themselves to the herbs; let gushes of rain gladden the earth, let herbs of all forms be born here and there; .....let the herbs become full of delight with the coming of the rainy season."

HYMN 50.[2]

This hymn enumerates the animal enemies of corn and invokes the divine aid for their destruction. The locust, the rat, the devourers of corn, and the borers figuring in this hymn are precisely the animals that we meet to-day,

[1] Atharva Veda, Book IV, p. 172.
[2] " " " VI, p. 317.

After all, from verses like these it is clear that the agricultural condition of India, like other conditions, is not materially different from what existed in the days of old.

HYMN 142.[1]

This hymn distinctly shows that at one time barley happened to be the staple food of the Indians to the extent of being regarded as a fit object for invocation. And this hymn indicates a note of jubilation at the abundance of the growth of this corn.

HYMN 59[2]: *For Protection of Cattle.*

This hymn and the one following show how cattle used to be held as precious:

"To the draft-oxen [do thou] first, to the milch kine [do thou], O *Arundhatī* (the commentator identifies it with *Sahadevī*), to the non-milch cow, in order to vigour, to the four-footed creatures do thou yield protection." 1.

HYMN 21[3]: *Praise of the Kine.*

"They shall not be lost; no thief shall harm (them); no hostile (person) shall dare attack their track: with whom he both sacrifices to the gods and gives, long verily with them does the kine-lord go in company." 3.

[1] Atharva Veda, Book VI, p. 387.
[2] " " " VI, " 325.
[3] " " " IV, " 187.

"No dust-raising horseman reaches them; nor unto the slaughter-house do they go, etc." 4.

"Rich in progeny, shining in good pasture, drinking clear waters at a good watering-place—let not the thief master you, nor the evil plotter; let Rudra's weapon avoid you." 7.

SECTION III

DEVELOPMENT DURING MAURYA PERIOD

By the 4th century B. C. the art of Agriculture received a consummate perfection. It became an important department[1] of the Government, a special officer, called the Superintendent of Agriculture, being appointed for the management and supervision of the important industry. This dignitary was to be a man of accurate and scientific knowledge of the subject, or "assisted by those who are trained in such sciences."

The duty of the Superintendent was a very extensive one. He was to "collect the seeds of all kinds of grains, flowers, fruits, vegetables, bulbous roots, roots, creepers, fibre-producing plants, and cotton." He was to see that the cultivation of the crown land should suffer on no account and enforce laws governing the proper cultivation of the soil.

[1] Chapter XXIV, Sections 117, 118, pp. 138-142.
(Dr. Shama Śastri's translation and edition, 1923.)
For original Sanskrit text see Arthaśāstra of Kautilya edited by R. Shama Sastri, Mysore Oriental Library Publications—Sanskrit Series, No. 64, 1919, pp. 115-118.

"The work of these men (slaves, labourers and prisoners) shall not suffer on account of any want in ploughs (*karshanayantra*) and other necessary instruments or of bullocks. Nor shall there be any delay in procuring to them the assistance of blacksmiths, carpenters, borers (*medaka*), rope-makers, as well as those who catch snakes and similar persons.

"Any loss due to the above persons shall be punished with a fine equal to the loss."

The meteorological observations conducted in connection with and in the interest of Agriculture over the whole of India seem to be simply marvellous for that age.

"The quantity of rain that falls in the country of *Jāngala* (in the desert countries—com.) is 16 drōṇas; half as much more in moist countries (*anūpānām*); as to the countries which are fit for agriculture (*dēśavāpānām*)—13½ drōṇas in the country of *Aśmakas* (the countries of Maharashtra—com.); 23 drōṇas in *Avanti*, and an immense quantity in Western countries (*aparāntānām*—the countries of Koṅkaṇa), the borders of the Himalayas, and the other countries where water channels are made use of in agriculture (*kulyāvāpānām*).

"When one-third of the requisite quantity of rain falls both during the commencement and closing months of the rainy season (months

of *Srāvaṇa* and *Kārtika*—com.) then the rainfall is (considered) very even (*sushamārūpam*).

"A forecast of such rainfall can be made by observing the position, motion and pregnancy (*garbhādhāna*) of Jupiter (Bṛhaspati), the rise, set and motion of Venus, and the natural and the unnatural aspect of the sun.

"From the sun, the sprouting of the seeds can be inferred; from (the position of) Jupiter, the formation of grains (*stambakaritā*) can be inferred and from the movement of Venus, rainfall can be inferred.

"Three are the clouds that continuously rain for seven days; eighty are they that pour minute drops; and sixty are they that appear with the sunshine—this is termed rainfall. Where rain free from wind and unmingled with sunshine falls so as to render three turns of ploughing possible, there the reaping of a good harvest is certain.

"Hence, *i.e.*, according as the rainfall is more or less, the Superintendent shall sow seeds which require either more or less water" (p. 139).

The Superintendent was also to see that seeds of crops are properly sown and reared in their proper seasons, in proper fields and under circumstances and conditions favourable to the growth. Thus:

"The Superintendent shall grow wet crops (*kedāra*), winter crops (*haimana*), or summer

crops (*graishmika*) according to the supply of workmen and water.

"Lands that are beaten by foam (*phenāghātaḥ*, *i.e.*, banks of rivers, etc.), are suitable for growing *Vallīphala* (pumpkin, gourd, and the like); lands that are frequently overflown by water (*parivāhāntā*) for long pepper, grapes (mṛdvikā), and sugarcane; the vicinity of wells for vegetables and roots, low grounds (*haraṇiparyantaḥ*—moist beds of lakes—*com.*) for green crops; and marginal furrows between any two rows of crops are suitable for the plantation of fragrant plants, medicinal herbs, khuskhus roots (*uśīra*), hira (?), beraka (?) and piṇḍāluka (lac) and the like.

"The seeds of grains are to be exposed to mist and heat (*tushārapāyanamushṇam cha*) for seven nights; the seeds of *Kōsī* (such as mudga and māsha, etc.—*com.*) are treated similarly for three nights; the seeds of sugarcane and the like (*kāṇḍabījānām*) are plastered at the cut end with the mixture of honey, clarified butter, the fat of hogs, and cowdung; the seeds of bulbous roots (*kanda*) with honey and clarified butter, cotton seeds (*asthibīja*) with cowdung; and water pits at the roots of trees are to be burnt and manured with the bones and dung of cows on proper occasions.

"The sprouts of seeds, when grown, are to be manured with a fresh haul of minute fishes and

irrigated with the milk of *Snuhi* (Euphorbia antiquorum).

" *Śāli* (a kind of rice), *Vrīhi* (rice), *Kodrava* (Paspalum scrobiculatum), *Tila* (sesamum), *Priyaṅgu* (panic seeds), *Dāraka* (?) and *Varaka* (Phaseolus trilobus) are to be sown at the commencement (*pūrvāvāpaḥ*) of the rainy seasons. *Mudga* (Phaseolus mungo), *Māsha* (Ph. radiatus) and *Śaivya* (?) are to be sown in the middle of the season. *Kusumbha* (Safflower), *Masura* (Ervum hirsutum), *Kulattha* (Dolichos biflorus), *Yava* (Barley), *Godhūma* (wheat) , *Kalāya* (Leguminous seeds), *Atasī* (linseed), and *Sarshapa* (mustard) are to be sown last."[1]

The Greek ambassador at the Court of Chandra Gupta—**Megasthenes**—a contemporary of the author of Arthaśāstra, pays[2] an eloquent tribute to the abundance of crops in India, to the fertility of the soil, to the absence of famine and the peculiar respect in which agriculture and the agriculturists were held. Even at the time of war the combatants used to leave the agriculturists undisturbed as a matter of duty.

[1] All the quotations are from Dr. Shama Śastri's English edition, see *supra*, p. 198.

[2] Fragments of Indika of Megasthenes, Bonn 1846. (Dr. E. A Schwanbeck.)

Thus he says in :

FRAGMENT I

" India has many huge mountains which abound in fruit trees of every kind, and many vast plains of great fertility. The greater part of the soil, moreover, is under irrigation and consequently bears two crops in the course of the year." 35.

"In addition to the cereals there grows throughout India much millet.........and much pulse of different sorts and rice also, and what is called Bosmorum, as well as many other plants useful for food of which most grow spontaneously. 36 (9).

"It is accordingly affirmed that famine has never visited India and that there has never been a general scarcity in the supply of nourishing food. 36 (10).

" But, further, there are usages observed by the Indians which contribute to prevent the occurrence of famine among them, for, whereas among other nations in the contests of war to ravage the soil and thus to reduce it to an uncultivated waste is the practice, among the Indians on the contrary by whom husbandmen are regarded as a class that is sacred and inviolable, the tillers of the soil, even when battle is raging in their neighbourhood, are undisturbed by any sense of danger for the

combatants on either side in waging the conflict make carnage of each other but allow those engaged in husbandry to remain quite unmolested. Besides, they neither ravage an enemy's land with fire nor cut down its trees."[1] 36 (14).

[1] *Cf.* also Aiyangar, Ancient India, p. 18 (1911).

FRAGMENT XI

On the fertility of India

"During the rains flax is sown, and millet, also sesamum, rice and bosmorum, and in the winter time wheat, barley, pulse and other esculent fruits unknown to us."[1]

The grandson of Chandragupta, **Aśoka,** as it is clear from one of his edicts[2] looked upon the encouragement of agriculture not only as a political duty (as Chandragupta did) but also as a moral duty.

[1] Other foreign observers also dwell upon the perfection of agriculture and the fertility of the soil in India. Thus Strabo, coming long after Megasthenes, remarks:

"During the rainy season flax and millet as well as bosmorum are sown and in the winter season wheat, barley, pulses and other esculents with which we are unacquainted" 13.

"They (Nearchos and Aristoboulos) add that the land while but still half dried is sown, and though scratched into furrows by any common labourer, it nevertheless brings what is planted to perfection and makes the fruit of good quality. Rice according to Aristoboulos stands in water, and is sown in beds. The plant is 4 cubits in height, has many ears and yields a large produce. Megillos says that rice is sown before the rains, etc." 18.

Strabo, Ancient India. McCrindle (1901), Secs. II-IV, Bk. XV, 13, 18.

[2] "Everywhere in the dominions of His Sacred and Gracious Majesty the King, as well as among his frontagers, the Cholas, the Pāndyas, the Satyaputra, the Ketalaputra as far as the Tāmbaparṇī, Antiochos, the Greek king or even the kings, the neighbours of that Antiochos—everywhere have been made the healing arrangements of His Sacred and Gracious Majesty in two kinds, (namely) healing

By the time of **Manu** the duty of looking to the agricultural interest of the country became codified[1] into a law, and a special class of people versed in the knowledge of correct measurement and weight, as also good and bad qualities of the soil, sprang up known as *Vaiśyas*. Thus:

"If the land be injured by the fault of the farmer himself, as if he fails to sow it in due time, he shall be fined ten times as much as the King's share of the crops that might otherwise have been raised." Code \ III, 243.

"Again a *Vaiśya* must be skilled in seeds, and in the bad or good qualities of land and the correct modes of measuring and weighing."

Code IX, 330.

arrangements for men and healing arrangements for beasts. Medicinal herbs also, both medicinal herbs for men and medicinal herbs for beasts, wheresoever lacking have been everywhere both imported and planted. Roots also, and fruits wheresoever lacking have been everywhere imported and planted. On the roads too wells have been dug and trees planted for enjoyment of men and beasts."

Tablet II, Edict II (of Aśoka)—

(*a*) Vincent Smith, Aśoka, p. 160, 3rd Ed.

(*b*) Dr. Bhandarkar and S. N. Majumdar, The Inscriptions of Asoka, pp. 4-6 (1920).

[1] Mrs. Spier, Life in Ancient India, Book I, Chap. VII, p. 151 (1856, London).

SECTION IV

KṚISHI-PARĀŚARA

A very valued treatise called *Krishi-Parāśara* of uncertain date, but composed certainly not later than the 5th century A.D., devoted principally to the plantation of paddy and secondarily to other things concerning agriculture, throw a flood of light upon the perfection attained by the Art of Agriculture in India. It deals with such topics as meteorological observations leading to the prediction of the scarcity, drought and abundance of rain ; superintendence of the field and its produce ; tending of the herd needed for cultivation ; preparation and application of manure ; the construction of agricultural implements, collection of seeds ; sowing ; harvesting, etc., etc. This treatise is all-comprehensive being full of a large number of pregnant aphorisms relating to the minutest particulars of agricultural processes.

A verse [1] concerning the ploughing of land runs :

"By ploughing the land in autumn one gets the goodliest of harvests (golden) and by

[1] "हेमन्ते कृष्यते हेम वसन्ते ताम्ररौप्यकम् ।
धान्यं निदाघकाले तु, दारिद्र्यन्तु घनागमे ॥"

ploughing it in spring one gets the next best (copper and silver), by ploughing in summer one gets simple paddy (*i.e.*, of the third order), and ploughing in the rainy season one gets absolute dearth."

There is another[1] relating to the sowing of paddy:

"The month of *Baiśakh* is the best time for sowing seeds of paddy, the next is *Jaishṭha*, *Áshāṛ* is bad for the purpose and *Śrāvaṇ* is the worst."

Here is another[2] telling us how to manure the land.

"After sunning the manures and grinding them in the month of *Māgh* one should bury them in the fields in the month of *Fālgoon* and then on the eve of sowing should apply them to the soil, else the yields of crops will not increase."

[1] "वैशाखे वपनं श्रेष्ठं ज्येष्ठे तु मध्यमं स्मृतम ।
आषाढे चाधमं प्राहुः श्रावणे चाधमाधमम् ॥"

Cf. also "रोपणार्थन्तु वीजानां शुचौ वपनमुत्तमम् ।
श्रावणे चाधमं प्रोक्तं भाद्रे चैवाधमाधमम ॥"

[2] "रौद्रे संशोध्य तत्सर्व्वं कृत्वा गुण्ड् करूपिणम् ।
फाल्गुने प्रति केदारे गर्त्तं कृत्वा निधापयेत् ॥
ततो वपनकाले तु कुर्य्यात् सारविमोचनम् ।
विना सारेण यद्धान्यं वर्द्धते न फलत्यपि ॥"

Let us quote last a verse from *Krishi-Parāśara* concerning the construction of the plough:

"पञ्चहस्तो भवेदीशः स्थाणुः पञ्चवितस्तिकः ।
सार्द्धहस्तस्तु निर्य्योलः युगः कर्णसमानकः ॥
निर्य्योलपाशिका चैव अड्डचल्लस्तथैव च ।
द्वादशाङ्गुलिमानोहि शौलोऽरत्निप्रमाणकः ॥
सार्द्धद्वादशमुष्टि र्वा कार्य्या वा नवमुष्टिका ।
दृढ़ा पञ्चनिका ज्ञेया लौहाग्रा वंशसम्भवा ॥"

SECTION V

KHANĀ'S MAXIMS

The striking resemblance between some of the aphorisms of Khanā relating to agriculture and some of the verses in *Krishi-Parāśara* on the same subject may warrant us in the supposition that the authentic treatise in Sanskrit might have a good deal to do with the mythical author of the aphorisms of Khanā who has carried the lessons contained in the *Krishi-Parāśara* to particular applications in minute details.

The aphorisms of Khanā bearing on agriculture may be classified under the following heads :

1. General maxims governing the conduct of the cultivators. 2. Meteorological observations with a view to the guidance of the farmers. 3. Selection of the soil. 4. Ploughing. 5. Sowing and planting. 6. Reaping and harvesting, etc. The number of maxims under each of these heads is too large to be given except in typical selections :

1. *General Maxims governing the Conduct of the Cultivators.*

" The master who gets the soil cultivated either by himself or in co-operation with others

reaps the full harvest, and next the man who gets the same done by others, himself standing with umbrella spread over his head (*i.e.*, without taking part himself), and the man who sits at home and takes care of his soils thence (*i.e.*, who takes only a theoretical care of his soil) is fated to a life of penury."

"The cultivation should be conducted in co-operation of the father with the son, and failing that of a brother with a brother."

The whole drift is that the cultivation should be done by men themselves directly interested in the prosperity of the harvest.

2. *Predictions as to the Influence of Timely and Untimely Showers upon the Crops.*

"If it rains in the month of *Agrahāyaṇ* the very king is driven to begging; and if in *Pous* the husks are sold in their weight in gold; and if in the month of *Māgh*, the country might be regarded as blessed and the sovereign might be congratulated thereon; and if in *Fālgoon*, *Chinā* and *Kāon* (grains) will grow very plentifully."

"The year in which it rains cats and dogs on the ninth day of the full moon in the month of *Āshāṛ*, the crane will walk over the very bottom of the sea (*i.e.*, absolute drought will visit the land); O! Father-in-law, you need not bother yourself about the further calculation in this matter. If it drizzles on that day it

will be followed by a heavy shower of rain throughout the whole year to the extent of making the fish inhabit the tops of mountains (*i.e.*, whole country will be over-flooded). If it rains now and then throughout the year the very earth will not be able to bear the weight of the harvest. If the sky remains clear at the setting of the Sun the farmer will have to sell his bullocks in the market, *i.e.*, the corns will not grow at all."

" Drought in *Jaishṭha* and shower in *Âshāṛ* lead to the growth of corn too plentiful for the earth to bear."

"If wind blows from the north-east at the beginning of the year it is sure to have a good shower according to Khanā."

" Khanā says this to the cultivator that if fleecy cloud be followed by wind in the full moon in the month of *Kārtik* the winter crops will grow too plentiful for the earth and if there be both cloud and rain at night it is altogether useless to go to the field, *i.e.*, the crops will not grow."

3. *Selection of the Soil.*

As the *Soil of Bengal* is unusually fertile, being fit for all kinds of crops, the maxims of Khanā which have almost solely Bengal in view are too few under this head.

" You worthy cultivator, your aim will be fulfilled if you grow *Paṭôl* (Trichosanthes dioica) in the sandy alluvial soil."

"The sandy soil is fit for the cultivation of *Âus* paddy and clayey soil for that of Jute."

"If you grow Arum on the bank of a river it will grow to the height of three cubits, *i.e.*, it will flourish well."

4. *Ploughing the Land for Crops.*

Elaborate attention is given to the methods of ploughing, thus :

"One should plough the soil sixteen times (*i.e.*, many times) for radishes ; half the number of times for cotton ; and half of that for paddy and none at all for betel."

"One should cultivate the soil for radishes making it as soft as cotton, *i.e.*, to the extremity of softness and for sugar-cane plough it to the dust."

"Khanā directs, O cultivators, begin the ploughing from the east and surely all your aims shall be fulfilled."

"The man who sets his hands to the plough either on the days of the full moon or the new moon, will be fated to suffer sorrows throughout the whole life. His bullocks will suffer from gout (*i.e.*, remain inactive), and he will suffer from eternal lack of peace. He who violates this injunction of Khanā will do so at his peril."

5. *Sowing and Planting.*

The treatment under this head is both exhaustive and elaborate.

" By sowing paddy in the month of *Âshāṛ* one gets a full harvest, in *Śrāvaṇ* only leaves and no fruits, in *Bhādra* only husks and in *Āświn* nothing."

" Sow paddy to your heart's content throughout the whole of *Śrāvaṇ* and the first 12 days of *Bhādra*."

" During the last four days of *Bhādra* and the first four days of *Āświn* sow *Kalāi* (Phaseolus var. radiatus) as much as you can (*i.e.*, best time)."

" One should sow Peas after the first 19 days of *Āświn* and within the first 19 days of *Kārtik*."

"Khanā directs, good cultivator, sow mustard towards the end of Autumn."

" The cultivator who does not plant either in the month of *Bhādra* or *Âświn* and idles away his time and then too late in the month of *Kārtik* and *Agrahāyaṇ* plants grown-up things in the field, is fated to see them perish from an attack of mildew and his barns empty."

" Sow turmeric in *Baiśākh* and *Jaishṭha*, bidding adieu to your chess-playing, weed out your soil in *Âshāṛ* and *Śrāvaṇ* so as to make it perfectly fit in *Bhādra*, otherwise no harvest will follow."

"This is the direction of Varāha's son Mihir: Excepting *Chaitra* and *Baiśākh* plant brinjals very cheerily throughout the other ten months. Apply ashes, if the plants are attacked by worms as the only remedy, pour water in case the ground is dry, and you will get fruits all the year round.

"Plant betel in *Śrāvaṇ* and the produce will be too much to be chewed up even by *Rāvaṇa*."

"*Paṭôls* will doubly grow if planted in *Fālgoon*.

"Plant plantains in holes one cubit deep each at intervals of 8 cubits, and do not cut off the leaves and it will yield you both bread and clothes."

6. *Reaping.*

The following maxims selected from among the rest contain directions for reaping the harvest.

"Corns ripen within 20 days after the first appearance of the ear, and one should cut and thresh the corn in 10 days more."

"The corn ripens 30 days after the first appearance of the spike, 20 days after the first appearance of flowers and 12 days after the ears are down after the appearance of a horse's head. Remember this, father-in-law! while making, buying and selling corns."

"During the last 8 days of *Fālgoon* and first 8 days of *Chaitra* one should reap the ripe sesamums."

"Cut the hemp plant (for the fibre) as soon as it flowers; the jute when it is mature; and autumn paddy if reaped during the month of *Pous* proves profitable."

SECTION VI

Amarakosha on Agriculture

The last comprehensive glimpse of the Art of Agriculture we get in the Lexicon of Amara which gives us an all-comprehensive information about the subject in the chapters called *Bhūmivarga*, *Vanaushadhivarga* and *Vaiśyavarga.*

In the *Vaiśyavarga* he deals with the class of people one of whose professions was agriculture. In the hierarchy of castes the *Vaiśyas*, the third in order, have come by this time to be exclusively professional cultivators of the lands, one of their names being *Bhūmisprisaḥ* (भूमिस्पृशः), *i.e.*, who touches (cultivates) the land, the husbandman being called *Kshetrājīvaḥ* (क्षेत्राजीवः).

Next, in the *Bhūmivarga*, he gives us a general classification of the soils based on fertility. The soil is called *Mṛttikā* (मृत्तिका) ; and excellent soil *Mṛtsā* (मृत्सा) ; a fertile soil with every crop *Urvvarā* (उर्व्वरा) or *Sarvaśasyāḍhyā* (सर्व्वशस्याढ्या) ; a salt ground—*Kshāra mṛttikā* (क्षारमृत्तिका) ; a spot with such soil *Ūshavānūshara* (ऊषवानूषर) ; barren soil—*Anurvvarā* (अनुर्व्वरा) ; a region devoid of water *Maru* (मरु) ; untilled or waste land—*Aprahate, Khile* (अप्रहते, खिले) ; the soil watered by a river—*Nadī-mātrikā* (नदीमातृका) and that watered by rain *Deva-mātrikā* (देवमातृका).

This is a nomenclature which is at once suggestive, exhaustive and sound, displaying a

perfect mastery over the fundamentals of agriculture so far as the soil is concerned.

Then he gives us, in the *Vaiśyavarga*, again different names for the different kinds of soils peculiarly fit for the cultivation of different kinds of crops—a fact from which we can incidentally gather a knowledge of the staple agricultural products of India which is not substantially different from those that we see to-day. Thus he calls the field fit for cultivating corn and rice, *Kshetram vraiheya śāleyam* (क्षेत्रं व्रैहेय-शालेयं); that fit for barley as *Yavyam, Yavakyam* (यव्यं, यवक्यं); that for Sesamum as *Tilam, Tailīnam* (तिल्यं, तैलीनम्); that fit for other grains, pulses, such as, mungo, lentil, gram, etc., as *Maudgīnam, Kaudrabīnā* (मौद्गीनं, कौद्रवीणा), etc. A field is called *Baprah* (वप्रः), *Kedāra* (केदारः), *Kshetram* (क्षेत्रं); a multitude of fields *Kaidārakam* (कैदारकम्); land twice ploughed is called *Dwiguṇākritam* (द्विगुणाकृतम्); thrice ploughed *Trihalyam* (त्रिहल्यं), *Trisītyam* (त्रिसीत्यं); and anyhow ploughed or tilled *Sītyam* (सीत्यम्), *Krishṭam* (कृष्टं); a field sown with certain measure of seeds *Drouṇikāḍhakikā* (द्रौणिकाढकिका) and land ploughed after sowing *Vījākritam* (*tu*) *Prakrishṭam* (बीजाकृतं (तु) प्रकृष्टम्).[1]

[1] In this connection might be added the following directions from the Matsya Purāṇam as to the selection of soils favourable to the growth of different types of corns ·

" The cultivator should sow some seeds of the type of corn he wishes to grow in a portion of the particular soil designed for the

Next he enumerates the agricultural implements :

A harrow is called *Kauṭiśam* (कौटिशं, लोष्टभेदन:) ; a goad, *Prājanam*, *Todanam* (प्राजनं, तोदनं) ; a spade or hoe, *Khanitram* (खनित्रं) ; a sickle, *Dātram*, *Labitram* (दात्र', लवित्रम्) ; the tie of the yoke (with which the ox is yoked to the plough, or, with which the yoke is fastened to the plough), *Yotram* (योत्रं) ; the body of the plough (the wood exclusive of the pole and share), *Nirisham*, *Kūṭhakam* (निरीषं, कूठकम्) ; the plough-share, *Phāla*, *Krishika* (फाल:, कृषिक:); the plough, *Lāngalam*, *Halam* (लाङ्गलम्, हलम्) ; the pin of yoke, *Yugakīlakaḥ* (युगकीलक:) ; the pole or shaft of the plough, *Lāngal-daṇḍaḥ* (लाङ्गलदण्ड:) ; a furrow, *Sītā* (सीता) ; the post of the threshing floor (round which cattle turn to tread out the grain), *Medhiḥ* (मेधि:) ; a pestle for clearing rice, *Ayogram*, *Musalaḥ* (अयोग्रं, मुसल:) ; a mortar, *Udūkhalam* (उदूखलम्) ; a winnowing basket, *Śūrppa*, *Prasphotanam* (शूर्प्पं, प्रस्फोटनं) ; sieve or cribble, *Chālanī*, *Titabhaḥ* (चालनी, तितभ:) ; a sack, *Syūtaḥ*, *Praseva* (स्यूत:, प्रसेव) ; threshed out and winnowed grain *Pūtam* (पूतं) and a granary *Kāṇḍāla* (काण्डाल).

purpose, and if the seeds planted sprout in three nights he will regard the soil as of the first order; and if in five nights as of the second order; and if in seven nights as of the last order. The soil which takes a longer time than this must be abandoned for good and all." (Matsyapurāṇam—Bangabāsi Ed., 1316 B.S., Chap. 253, Slokas 17, 18, p. 880.)

SECTION VII

CONCLUDING REMARKS

Our survey of the genesis and development of ancient Science of Agriculture shows that after it has reached a certain state of perfection there has been no further improvement in the method of cultivation, no accurate observation and no useful experiment. The scientific principles underlying the Art under unfavourable political circumstances came to be forgotten and agriculture instead of being a concern of the State, a matter of expert knowledge, came to be the occupation of the lowest strata of the population with the result that the fertile India noted by Megasthenes and others for its absolute absence of famine became repeated scenes of dearth and famine during the Mohamedan rules again and again, and many times during the British rule too.

CONCLUSION

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The thesis submitted is but a part of a larger work which is to follow. It is intended to serve as a mere sample of the kind of work which can be produced with the materials that can yet be gathered from the unexplored field of Indian literature and current traditions. The indebtedness of human civilisatian to plants and the study of plant-life is indeed very great. There is hardly any department of human culture, or any phase of human civilisation, whether it be pure poetry or pure philosophy or pure religion, science, art, language, dress and ornament, trade or agriculture, where plants and the study of plant-life have not played an important part.

Our thesis contains, we hope, sufficient evidence to show that the knowledge of Botany developed on three different lines, first, in and through various philosophical speculations; secondly, as *Bheshaja Vidyā*, in and through the Science of Medicine; and thirdly, as *Vrikshāyurveda*, in and through the Science of Agriculture. There are quotations from sources referring to some independent treatises, or manuals of the Science of the medicinal properties of plants, those of the Science of Agriculture, as well as works dealing with the treatment of

plants and other topics falling within the province of Botany. We have only glimpses of these manuals and works through the summaries and incidental references in other treatises which are non-Botanical. Even that which survives or remains, clearly indicates that the division of knowledge by water-tight compartments was yet unknown.

The inter-relation among the sciences was universally recognised, and the sciences and arts developed together. The obstacle in the path of development of the Botanical Science as a full-fledged science, was that scientific cognition and results of observations were not kept sufficiently distinct from the popular notions, guesses and superstitions.

Our study tends to prove that the Science of Plants and Plant-life in India is one of the earliest, if not the earliest one. With it developed such collateral sciences as those of Medicine and Agriculture. We know a good deal more of the Science of Medicine than of the Science of Agriculture, its sister, and of the Science of Plant and Plant-life, its mother. Our survey, however, shows that all these shared the same fate of a brilliant beginning, a marked progress to a certain stage, and a tragic stagnation.

The field is vast, our survey is brief but enough, we think, to hold out the prospects of a rich harvest that can be reaped by the modern

inquirer. The value of the work is primarily historical no doubt, enabling one, as it does, to be acquainted with the circumstances and the difficulties through which human knowledge and art grew up, but its value also consists in discovering different systems of nomenclature and classification, suggestive of different trends of human thought and national culture.

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OPINION.

I have gone through the essay on "Plant-life, etc.," submitted for the Griffith Memorial Prize for 1925.

The author has evidently ransacked all the available sources of old Sanskrit literature from the Rik and Atharva Vedas down to the period when the decline of Arts and Science took place in India. Even the aphorisms of Khana—a repository of worldly wisdom and experience—have been laid under contribution, and an admirable capacity for research has been displayed. As the author is conversant with the modern science of Botany, he has been able to do ample justice to his theme. The collection of technical terms alone constitutes a valuable contribution. In my opinion the author richly deserves the Prize. I would also suggest that the essay be published by the University as a valuable monograph in a practically unexplored field.

P. C. RAY.

I have examined the thesis entitled "Plants and Plant-life as in Indian Treatises and Traditions" submitted for the Griffith Memorial Prize for 1925.

The author has explored a vast field of Sanskrit literature (including English reviews and commentaries on early Sanskrit works) and collected a mine of information replete with gems of botanical facts and aphorisms. The essay embodies not merely a collection of fragments of early speculation on plant-life but a critical survey of the botanical knowledge of the Hindus and its application to Medicine and Agriculture, in the searchlight of modern Science. The author has, with the grasp of a trained botanist, succeeded in marshalling evidence to show clear indications of possession by the ancient Hindus of such knowledge of plant-life as prognosticate the dawn of science.

The thesis is a most creditable specimen of work in a field of research of great promise, and I consider the author as highly deserving of the prize.

S. C. Mahalanobis.